Application Guidelines

Allen-Bradley

# Drives in Common Bus Configurations

## Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation, Inc., is prohibited.

Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

| | |
|---|---|
| | **WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss. |
| | **ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence. |
| **IMPORTANT** | Identifies information that is critical for successful application and understanding of the product. |

Labels may also be on or inside the equipment to provide specific precautions.

| | |
|---|---|
| | **SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present. |
| | **BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures. |
| | **ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE). |

Allen-Bradley, Rockwell Software, and Rockwell Automation are trademarks of Rockwell Automation, Inc.

Trademarks not belonging to Rockwell Automation are property of their respective companies.

This manual contains new and updated information.

## New and Updated Information

This table contains the changes made to this revision.

| Topic | Page |
|---|---|
| In Chapter 1 in the Precharge section, added new subsections for:<br>• PowerFlex 520-Series Frame A, B, and C AC Drives<br>• PowerFlex 520-Series Frame D AC Drives<br>• PowerFlex 520-Series Frame E AC Drives<br>• PowerFlex 750-Series Frame 8…10 AC Input 'Stand-alone' Drives.<br>• PowerFlex 750-Series Frame 8…10 DC Input 'Common Bus' Drives. | <br>19<br>19<br>20<br>23<br>25 |
| In Chapter 2, expanded PowerFlex SCR Bus Supply section by adding information on solid ground, high resistance ground, and ungrounded systems. | 31 |
| In Chapter 3:<br>• Moved 1336 and AK DBU brake devices information to new Appendix C.<br>• Expanded PowerFlex SCR Bus Supply section by adding information on solid ground, high resistance ground, and ungrounded systems. | 39 |
| In Chapter 7, moved 1336 and AK DBU brake devices information to new Appendix D. | 71 |
| In Chapter 8, removed 1336REGEN bus supply information, and added new diagrams and related tables. | 77 |
| In Chapter 9, added new diagrams and related tables. | 87 |
| In Chapter 10, updated diagram and related table. | 97 |
| Deleted Chapters 11 and 12, and moved information on the 1336 REGEN bus supply to new Appendix C. | 145 |
| In Appendix A, added fusing tables for the following drives:<br>• 325V DC Input Fuses for PowerFlex 520-Series drives.<br>• 540V DC Input Fuses for PowerFlex 520-Series drives.<br>• 650V DC Input Fuses for PowerFlex 520-Series drives.<br>• 810V DC Input Fuses for PowerFlex 520-Series drives.<br>• 540V DC Input Fuses for PowerFlex 750-Series Frame 1…7 drives<br>• 540V DC Input Fuses for PowerFlex 750-Series Frame 8…10 drives.<br>• 650V DC Input Fuses for PowerFlex 750-Series Frame 1…7 drives.<br>• 650V DC Input Fuses for PowerFlex 750-Series Frame 8…10 drives.<br>• 810V DC Input Fuses for PowerFlex 750-Series Frame 3…7 drives.<br>• 810V DC Input Fuses for PowerFlex 750-Series Frame 8…10 drives.<br>• 932V DC Input Fuses for PowerFlex 750-Series Frame 6 and7 drives.<br>• 932V DC Input Fuses for PowerFlex 750-Series Frame 8…10 drives. | <br>102<br>104<br>111<br>118<br>107<br>108<br>116<br>117<br>122<br>123<br>127<br>128 |
| In Appendix B, added the following new sections:<br>• Common Mode Core<br>• DC Bus Conditioners—Designs A, B, C, D, or E<br>• DC Bus Clamp—Designs F or G<br>• Ground Fault Indicator Filter<br>• Zig-Zag Transformer | <br>136<br>139<br>142<br>143<br>144 |
| Added new Appendix C, 1336 REGEN Drives. | 145 |
| Added new Appendix D, 1336 and AK DBU Brake Devices. | 159 |

## Notes:

**Preface**

Introduction . . . . . 11
Definitions of Common Bus Configurations . . . . . 11
Common DC Bus—Non-regenerative . . . . . 11
Common DC Bus—Non-regenerative with Braking Chopper . . . 11
Shared AC/DC Bus . . . . . 11
Shared AC/DC Bus—with Braking Chopper . . . . . 11
Shared DC Bus (Piggy Back) . . . . . 11
Shared DC Bus (Piggy Back)—with Braking Chopper . . . . . 12
Regenerative Bus Supply (Active Front End) . . . . . 12
Regenerative Braking . . . . . 12
Shared Regenerative Braking . . . . . 12
Parallel Regenerative Braking . . . . . 12
Reference Materials . . . . . 12
Technical Support (SupportPlus™) . . . . . 14

**Chapter 1**

**General Considerations**

DC Bus Wiring Guidelines . . . . . 15
Drive Line-up . . . . . 15
DC Bus Connections . . . . . 15
Precharge . . . . . 16
PowerFlex 40P Frame B AC Drives . . . . . 18
PowerFlex 40P Frame C AC Drives . . . . . 18
PowerFlex 520-Series Frame A, B, and C AC Drives . . . . . 19
PowerFlex 520-Series Frame D AC Drives . . . . . 19
PowerFlex 520-Series Frame E AC Drives . . . . . 20
PowerFlex 70 Frame E, PowerFlex 700/700S Frame 0...4, and PowerFlex 750-Series Frame 1...4 AC Drives . . . . . 20
PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7...10 AC Input 'Stand-alone' Drives . . . . . 21
PowerFlex 700H/700S Frame 9...14 AC Input 'Stand-alone' Drives . . . . . 21
PowerFlex 750-Series Frame 5...7 AC Drives . . . . . 22
PowerFlex 750-Series Frame 8...10 AC Input 'Stand-alone' Drives . . . . . 23
PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7...10 DC Input 'Common Bus' Drives . . . . . 23
PowerFlex 700H/700S Frame 9...14 DC Input 'Common Bus' Drives . . . . . 24
PowerFlex 750-Series Frame 5...7 DC Input 'Common Bus' Drives . . . . . 25
PowerFlex 750-Series Frame 8...10 DC Input 'Common Bus' Drives . . . . . 25
PowerFlex 700L Frame 2, 3A, and 3B AC Input 'Stand-alone' Drives . . . . . 26

PowerFlex 700L Frame 3A and 3B DC Input 'Common Bus' Drives ... 26
Kinetix 7000 Catalog Number BM06...BM08 Servo Drives ... 27
Kinetix 7000 Catalog Number BM09...BM12 Servo Drives ... 27
Kinetix 6000 Bxxx-Series and Kinetix 6200/6500 Multi-Axis Servo Drives ... 28

## Chapter 2

**Common DC Bus Configuration—Non-Regenerative**

System Characteristics ... 29
Supported Products ... 29
Typical System Configuration ... 30
PowerFlex Diode Bus Supply ... 30
PowerFlex SCR Bus Supply in Solid Ground System ... 31
PowerFlex SCR Bus Supply in High Resistance Ground System ... 32
PowerFlex SCR Bus Supply in Ungrounded System ... 33
General Considerations ... 34
PowerFlex Diode Bus Supply Considerations ... 35
PowerFlex SCR Bus Supply Considerations ... 35
Sizing ... 36
PowerFlex Diode Bus Supply ... 36
PowerFlex SCR Bus Supply ... 37
Fusing ... 37
DC Input Drives ... 37
PowerFlex Diode Bus Supply ... 37
PowerFlex SCR Bus Supply ... 37

## Chapter 3

**Common DC Bus Configuration—Non-Regenerative with Braking DC Bus Regulation**

System Characteristics ... 39
Supported Products ... 39
Typical System Configurations ... 40
Brake Chopper Modules ... 40
Drive Internal Brake IGBT ... 44
General Considerations ... 46
PowerFlex Diode Bus Supply Considerations ... 47
PowerFlex SCR Bus Supply Considerations ... 48
Sizing ... 48
Drive Internal Brake IGBT ... 48
Bus Supplies ... 48
Fusing ... 50
DC Input Drives ... 50
PowerFlex Diode Bus Supply ... 50
PowerFlex SCR Bus Supply ... 50

## Chapter 4

**Shared AC/DC Bus Configuration**

System Characteristics . . . . . 51
Supported Products . . . . . 51
Typical System Configurations . . . . . 52
AC Drives of Different Frame Sizes from the Same Product Line . 52
Same Frame Size AC Drives from Same Product Line . . . . . 53
PowerFlex 40P or PowerFlex 520-Series Drives . . . . . 55
General Considerations . . . . . 55
Different Frame Size Drive Considerations . . . . . 56
Precharge . . . . . 56
Loading . . . . . 56
Same Frame Size Drive Considerations . . . . . 57
PowerFlex 40P or PowerFlex 520-Series Drive Considerations . . . . . 57
Sizing . . . . . 57
Fusing . . . . . 58

## Chapter 5

**Shared AC/DC Bus Configuration—with Braking DC Bus Regulation**

System Characteristics . . . . . 59
Supported Products . . . . . 59
Typical System Configurations . . . . . 61
General Considerations . . . . . 63
Different Size Drive Considerations . . . . . 64
Precharge . . . . . 64
Loading . . . . . 64
Same Size Drive Considerations . . . . . 65
PowerFlex 40P or PowerFlex 520-Series Drive Considerations . . . . . 65
Sizing . . . . . 65
Fusing . . . . . 66

## Chapter 6

**Shared DC Bus Configuration (Piggy Back)**

System Characteristics . . . . . 67
Supported Products . . . . . 67
Typical System Configurations . . . . . 68
General Considerations . . . . . 69
PowerFlex 40P or PowerFlex 520-Series Drive Considerations . . . . . 69
Sizing . . . . . 69
Fusing . . . . . 69

## Chapter 7

**Shared DC Bus Configuration (Piggy Back)—with Braking Chopper**

System Characteristics . . . . . 71
Supported Products . . . . . 71
Typical System Configurations . . . . . 73
General Considerations . . . . . 75
PowerFlex 40P or PowerFlex 520-Series Drive Considerations . . . . . 75

Sizing. . . . . 75
Fusing . . . . . 75

## Chapter 8

**Regenerative Bus Supply Configuration**

System Characteristics . . . . . 77
Supported Products. . . . . 77
Typical System Configurations . . . . . 78
Solid Ground System with Single AFE and Single AC Drive. . . . . 78
Solid Ground System with Single AFE and Multiple AC Drives . . 79
High Resistance Ground System with Single AFE and Single AC Drive. . . . . 80
High Resistance Ground System with Single AFE and Multiple AC Drives . . . . . 81
Ungrounded System with Single AFE and Single AC Drive . . . . . 82
Ungrounded System with Single AFE and Multiple AC Drives . . . 83
General Considerations . . . . . 84
Sizing. . . . . 84
Fusing . . . . . 85
DC Input Drives . . . . . 85
PowerFlex Active Front End. . . . . 85

## Chapter 9

**Multiple Regenerative Bus Supply Configurations**

System Characteristics . . . . . 87
Supported Products. . . . . 87
Typical System Configuration . . . . . 88
Solid Ground System with Multiple AFEs and Single AC Drive . . 88
Solid Ground System with Multiple AFEs and Multiple AC Drives . . . . . 89
High Resistance Ground System with Multiple AFEs and Single AC Drive. . . . . 90
High Resistance Ground System with Multiple AFEs and Multiple AC Drives . . . . . 91
Ungrounded System with Multiple AFEs and Single AC Drive . . . 92
Ungrounded System with Multiple AFEs and Multiple AC Drives . . . . . 93
PowerFlex Active Front End Considerations. . . . . 94
General Considerations . . . . . 94
Sizing. . . . . 94
Fusing . . . . . 95
DC Input Drives . . . . . 95
PowerFlex Active Front End. . . . . 95

## Chapter 10

**Paralleling Regenerative Bus Supplies (AFEs) with One or More Non-Regenerative PowerFlex SCR Bus Supplies**


System Characteristics . . . . . 97
Supported Products . . . . . 97
Typical System Configuration . . . . . 98
PowerFlex Active Front End and PowerFlex SCR Bus Supply Considerations . . . . . 99
General Considerations . . . . . 99
Sizing . . . . . 100
Fusing . . . . . 100
DC Input Drives . . . . . 100
PowerFlex SCR Bus Supply . . . . . 100
PowerFlex Active Front End . . . . . 100


## Appendix A

**PowerFlex Drive Ratings, Recommended DC Bus Fuses, and Drive DC Bus Capacitance**


325 Volt DC Input Fuses . . . . . 101
540 Volt DC Input Fuses . . . . . 103
650 Volt DC Input Fuses . . . . . 110
810 Volt DC Input Fuses . . . . . 118
932 Volt DC Input Fuses . . . . . 124
Fuse Certification and Test Data . . . . . 129
JKS Fuses . . . . . 129
170M Fuses . . . . . 131


## Appendix B

**Power Component Accessories**


Back-to-Back Diodes (Shared AC/DC Configurations) . . . . . 133
Considerations . . . . . 133
Diode Sharing Modules . . . . . 133
HF Filter (SCR Bus Supply) . . . . . 134
Bus Supply Capacitors . . . . . 134
SCR Bus Supply Minimum Capacitance . . . . . 134
Connecting High Power Drives and Low Power Drives on the DC Bus . . . . . 134
RC Snubber Circuit . . . . . 136
Common Mode Core . . . . . 136
Usage With SCR Bus Supply . . . . . 136
Usage With AFE . . . . . 137
External Drive Options . . . . . 138
Internal Drive Options . . . . . 139
DC Bus Conditioner—Designs A, B, C, D, or E . . . . . 139
Design A . . . . . 140
Design B . . . . . 141
Design C . . . . . 141
Design D . . . . . 141
Design E . . . . . 141

DC Bus Clamp—Design F or G . . . . . 142
Design F . . . . . 142
Design G . . . . . 142
Ground Fault Indicator Filter . . . . . 143
Zig-Zag Transformer . . . . . 144

## Appendix C

**1336 REGEN Drives**

Supported Products . . . . . 145
Typical System Configurations . . . . . 146
1336 REGEN Considerations . . . . . 147
Sizing . . . . . 147
Fusing . . . . . 149
AC Input 1336 REGEN . . . . . 149
1336 REGEN Drive in Regenerative Braking Configuration . . . . . 150
System Characteristics . . . . . 150
Supported Products . . . . . 150
Typical System Configurations . . . . . 151
General Considerations . . . . . 152
1336 REGEN Considerations . . . . . 152
Sizing . . . . . 152
Fusing . . . . . 153
1336 REGEN Drive in Shared Regenerative Braking Configuration . 154
System Characteristics . . . . . 154
Supported Products . . . . . 154
Typical System Configurations . . . . . 155
General Considerations . . . . . 156
1336 REGEN Considerations . . . . . 156
PowerFlex 40P Drive Considerations . . . . . 156
Sizing . . . . . 157
Fusing . . . . . 157

## Appendix D

**1336 and AK DBU Brake Devices**

. . . . . 159

## Introduction

An increasing number of drive systems in a wide range of applications and power ranges are being configured today in common bus configurations. These common bus drive system configurations provide significant advantages such as, design flexibility, higher efficiency, and cost savings.

It is the objective of this publication to provide the necessary guidelines, considerations, and limitations for the proper application of PowerFlex drives used in common bus configurations.

For Allen-Bradley common bus standard products, see the Common DC Bus Selection Guide, publication DRIVES-SG001.

## Definitions of Common Bus Configurations

### Common DC Bus—Non-regenerative

Three-phase diode, SCR bridge front-end, or a combination of these two. A single-direction power flow, full-wave bridge converts 3-phase AC voltage to a fixed DC bus voltage. One or more drives are connected through the DC bus.

### Common DC Bus—Non-regenerative with Braking Chopper

Same as Non-regenerative, but with an added resistive braking module to dissipate excess regenerative DC bus energy.

### Shared AC/DC Bus

Stand alone drives fed by a common 3-phase AC voltage source with the DC bus of each drive connected together.

### Shared AC/DC Bus—with Braking Chopper

Same as Shared AC/DC Bus, but with an added resistive braking module to dissipate excess regenerative DC bus energy.

### Shared DC Bus (Piggy Back)

One stand-alone drive is used as the common converter section for multiple shared DC bus drives. The incoming AC power is fed to the drive used as the common converter only. The drive used as the common converter sources DC power to the smaller drive or drives through the DC link connections.

### Shared DC Bus (Piggy Back)—with Braking Chopper

Same as Shared DC Bus, but with an added resistive braking module to dissipate excess regenerative DC bus energy.

### Regenerative Bus Supply (Active Front End)

A Pulse Width Modulated (PWM) controlled IGBT converter enables regeneration to the AC line. One or more drives are connected to the DC bus. An Active Front End can be connected in parallel to a non-regenerative converter.

### Regenerative Braking

A regenerative brake enables regeneration to the AC line. In this configuration, the drive has a connection to the AC line and draws the majority of the motoring power.

### Shared Regenerative Braking

Similar to the Regenerative Braking configuration, except multiple drives are connected to a single regenerative unit. Steering diodes are used to control flow of current.

### Parallel Regenerative Braking

Similar to the Regenerative Braking configuration, except multiple regenerative units are connected to a single drive.

## Reference Materials

The following publications provide useful information when planning and installing common bus products.

| Product | See | Publication |
|---|---|---|
| 1336-WA / -WB / -WC Brake Chopper Module | Installation Instructions | 1336-5.65 |
| 1336-MOD-KA / -KB / -KC Heavy Duty Dynamic Braking | Installation Instructions | 1336-5.64 |
| AK DBU Dynamic Braking Unit | AK DBU Dynamic Braking Unit 600/690 VAC User Manual | AKDBU-UM001 |
| 20S SCR Bus Supply | PowerFlex SCR Bus Supply User Manual | 20S-UM001 |
| 20T Diode Bus Supply | PowerFlex Diode Bus Supply User Manual | 20T-UM001 |
| PowerFlex® 40P Drive | PowerFlex 40P User Manual<br>PowerFlex 40P Quick Start | 22D-UM001<br>22D-QS001 |
| PowerFlex 520-Series Drive | PowerFlex 520-Series Adjustable Frequency AC Drive User Manual | 520-UM001 |

| | | |
|---|---|---|
| PowerFlex 700/700VC Series A Drive<br>PowerFlex 700VC Series B Drive | PowerFlex 700 Series A User Manual<br>PowerFlex 700 Series B User Manual<br>PowerFlex 70/700 Reference Manual<br>PowerFlex 70EC/700VC Reference Manual<br>PowerFlex 700 Technical Data<br>PowerFlex Dynamic Braking Resistor Calculator | 20B-UM001<br>20B-UM002<br>PFLEX-RM001<br>PFLEX-RM004<br>20B-TD001<br>PFLEX-AT001 |
| PowerFlex 700H Drive | PowerFlex 700H Installation Instructions<br>PowerFlex 700H Programming Manual<br>PowerFlex 700H Technical Data | PFLEX-IN006<br>20C-PM001<br>20C-TD001 |
| PowerFlex 700S Drive | PowerFlex 700S with Phase I Control Installation Manual (Frames 1…6)<br>PowerFlex 700S with Phase I Control Installation Manual (Frames 9 and 10)<br>PowerFlex 700S with Phase I Control User Manual (All Frame Sizes)<br>PowerFlex 700S with Phase I Control Reference Manual<br>PowerFlex 700S with Phase I Control Technical Data<br>PowerFlex 700S with Phase II Control Installation Manual (Frames 1…6)<br>PowerFlex 700S with Phase II Control Installation Manual (Frames 9…14)<br>PowerFlex 700S with Phase II Control Programming Manual (All Frame Sizes)<br>PowerFlex 700S with Phase II Control Reference Manual<br>PowerFlex 700S with Phase II Control Technical Data<br>PowerFlex Dynamic Braking Resistor Calculator | 20D-IN024<br>PFLEX-IN006<br>20D-UM001<br>PFLEX-RM002<br>20D-TD001<br>20D-IN024<br>PFLEX-IN006<br>20D-PM001<br>PFLEX-RM003<br>20D-TD002<br>PFLEX-AT001 |
| PowerFlex 700L Drive | PowerFlex 700L Liquid-Cooled Drive User Manual<br>PowerFlex 700L Active Converter Power Module User Manual<br>For Vector Control, see PowerFlex 700 Series B User Manual<br>For Phase II Control, see PowerFlex 700S w/Phase II Control Programming Manual | 20L-UM001<br>PFLEX-UM002<br>20B-UM002<br>20D-PM001 |
| PowerFlex 750-Series Drive | PowerFlex 750-Series Drive Installation Instructions<br>PowerFlex 750-Series EMC Plate and Core(s) - Frames 1…7 Installation Instructions<br>PowerFlex 755 AC Drives EMC Cores Installation Instructions<br>PowerFlex 750-Series Drive Programming Manual<br>PowerFlex 750-Series Drive Technical Data | 750-IN001<br>750-IN006<br>750-IN024<br>750-PM001<br>750-TD001 |
| PowerFlex AFE/PowerFlex 700AFE | PowerFlex Active Front End User Manual | 20Y-UM001 |
| 1336 REGEN Drive | Line Regeneration Package User Manual | 1336 REGEN-5.0 |
| 1321 Line Reactor & Isolation Transformers | Line Reactor and Isolation Transformer Technical Data<br>1321-M Common Mode Chokes Instructions | 1321-TD001<br>1321-5.0 |
| Kinetix 7000 Servo Drive | Kinetix 7000 Installation Instructions<br>Kinetix 7000 User Manual | 2099-IN003<br>2099-UM001 |
| Kinetix 6000 Multi-Axis Servo Drive | Kinetix 6000 Installation Instructions<br>Kinetix 6000 User Manual | 2094-IN001<br>2094-UM001 |
| Kinetix 6200/6500 Modular Multi-Axis Servo Drives | Kinetix 6200 and Kinetix 6500 Installation Instructions<br>Kinetix 6200 and Kinetix 6500 User Manual | 2094-IN012<br>2094-UM002 |

You can view or download publications at http://www.rockwellautomation.com/literature. To order paper copies of technical documentation, contact your local Allen-Bradley® distributor or Rockwell Automation sales representative.

To find your local Rockwell Automation distributor or sales representative, visit http://www.rockwellautomation.com/locations.

## Technical Support (SupportPlus™)

For consultation on high performance drive applications, the SupportPlus program is offered. SupportPlus uses expert-level Rockwell Automation system engineers to support the user's engineering team. SupportPlus engineers work with the end user to lay out the appropriate architecture, configure drives, recommend programming techniques, and provide application assistance on the most effective ways to implement the control solution.

| Service | Catalog No. |
|---|---|
| One-Hour Design Consultation | TS-SP1HR |
| Two-Hour Design Consultation | TS-SP2HR |
| On-Site Power Analysis | TS-PASIOS |

For more information, see http://www.ab.com/support/abdrives/files/supportplus.pdf.

# General Considerations

## DC Bus Wiring Guidelines

### Drive Line-up

Generally, it is desirable to have the drive line-up match the machine layout. However, if there is a mix of drive frame sizes used in the line-up, the general system layout must have the largest drives located closest to the rectifier source. The rectifier source can be anywhere within the system line-up. Many times it is advantageous to put the rectifier in the middle of the line-up, minimizing the distances to the farthest loads. This is needed to minimize the energy stored in the parasitic inductance of the bus structure and thus lower peak bus voltages during transient operation.

The system must be contained in one contiguous line-up. The bus cannot be interrupted to go to another cabinet for the remainder of the system drives. This is needed to maintain low inductance.

### DC Bus Connections

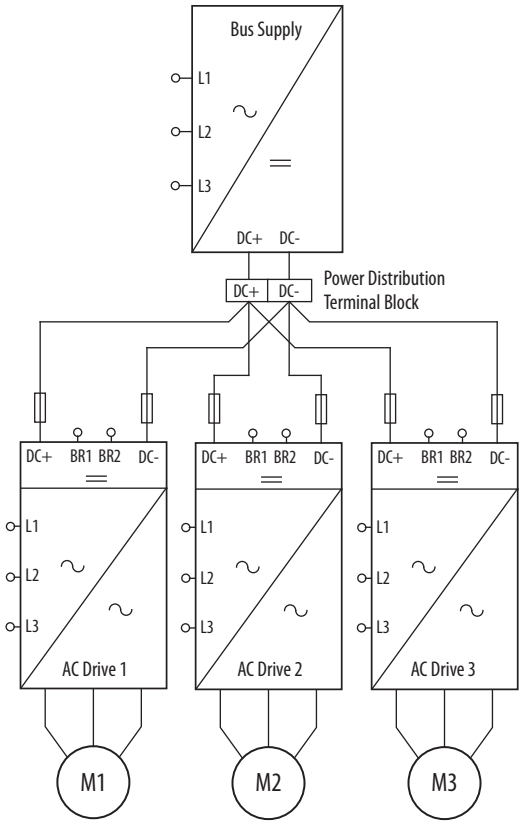
*General*

The interconnection of drives to the DC bus, and the inductance levels between the drives, must be kept to a minimum for reliable system operation.

*Bus Bar versus Cable*

- Bus bar is recommended.
- When bus bar cannot be used, adhere to the following guidelines for DC bus cables:
  - Keep the cable lengths as short as possible.
  - Twist cable where possible, approximately 1 twist per foot.
  - Use cable rated for the equivalent AC voltage rating. The peak AC voltage is equivalent to the DC voltage. For example, the peak AC voltage on a 480V AC system no load is 480 x 1.414 = 679 volts peak. The 679 volts peak corresponds to 679 volts DC at no load.
  - The DC bus connections cannot be 'daisy chained'. Use a 'star' configuration of the DC bus connections as shown in the following figure to enable proper fusing.

**Figure 1 - Star Configuration of Common Bus Connections**




*Braking Chopper*

Connection of the brake unit must be closest to the largest drive. If all are the same rating, then closest to the drive that regenerates the most.

The maximum wire length between the brake chopper and the highest power drive and between parallel brake choppers must be observed. See the respective braking product documentation for details.

An RC snubber can mitigate inductive voltage spike at brake off transitions.

## Precharge

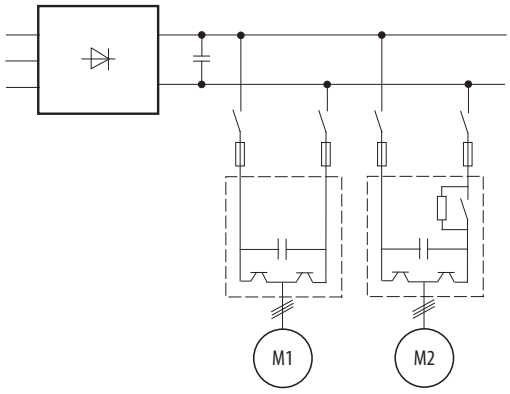
Precharge is the process through which the DC bus voltage of a drive is gradually increased. During this increase in DC bus voltage, the DC bus filtering capacitors are charged in a controlled manner. The precharge assembly can be part of the drive's design or provided and controlled externally by the user.

**ATTENTION:** An external source of power can be present. To avoid an electrical shock hazard, verify that the AC power supply has been removed prior to performing any maintenance.

If an external voltage source is being used to power the logic boards of the drives, precaution must be taken to control the precharge sequence. We recommend using the 'Precharge Enable' digital input on the drive for common bus operation. The logic input can be coordinated through a PLC or system-level control for precharge sequencing. This lets various horsepower drive charging time constants settle out before the precharge is closed. Generally, a 3 second delay after power application is acceptable.

When multiple drives are connected through disconnects to a common DC bus, it is generally necessary to provide an input to the drive that enables the precharge to close. Often this input is controlled by an auxiliary contact on the drive disconnect switch.

**Figure 2 - Common DC Bus Example**




The bus capacitors in the individual drives act as a low impedance voltage source. Extra care is needed when connecting individual drives to an energized bus.

**ATTENTION:** Kinetix servo drives have no method for the user to control the precharge sequence. Never connect Kinetix servo drives to an energized DC bus. Severe drive and/or equipment damage can result due to an uncontrolled precharge of the Kinetix drives.

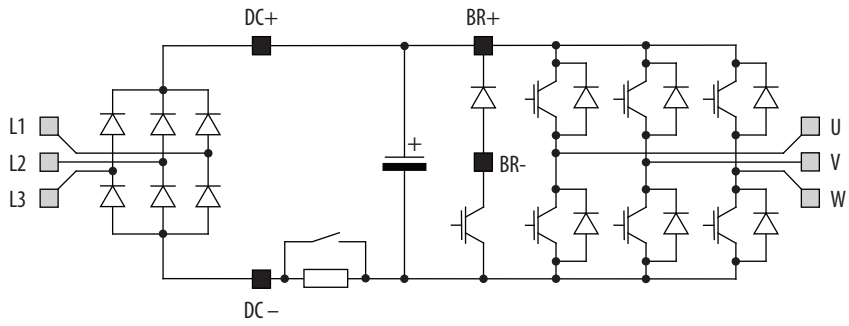
If 'Precharge Enable' is selected as a digital input, it must be energized to let the initial bus precharge complete. If it is de-energized, it is treated as a coast-to-stop command **and** it forces the drive to the initial bus precharge state. Fuse failure is probable unless coordination of precharge circuits in individual drives is implemented.

PowerFlex 700 drives and PowerFlex 700 Series B drives must have firmware revision 2.001 or later (Standard or Vector Control) for use in common bus configurations. When Kinetix 6000 drives are used in common bus configurations with PowerFlex drives, they must have firmware revision 1.92 or later. Kinetix 6200/6500 drives with any firmware revision can be used.

## PowerFlex 40P Frame B AC Drives

For PowerFlex 40P Frame B AC drives, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the negative DC bus, between the diode bridge and the bus capacitors. The resistor has a relay contact connected in parallel that closes when the bus precharge level has been reached, bypassing the precharge resistor. The precharge function operates the same way for either AC or DC input power.

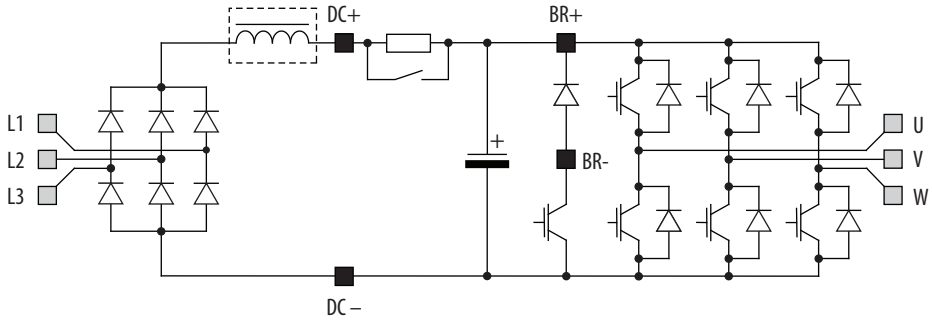
**Figure 3 - AC and DC Input Schematic for PowerFlex 40P Frame B AC Drives**




## PowerFlex 40P Frame C AC Drives

For PowerFlex 40P Frame C AC drives, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the positive DC bus, between the diode bridge and the bus capacitors. An external DC link inductor can be installed in series between the diode bridge and the precharge resistor. The resistor has a relay contact connected in parallel that closes when the bus precharge level has been reached, bypassing the precharge resistor. The precharge function operates the same way for either AC or DC input power.

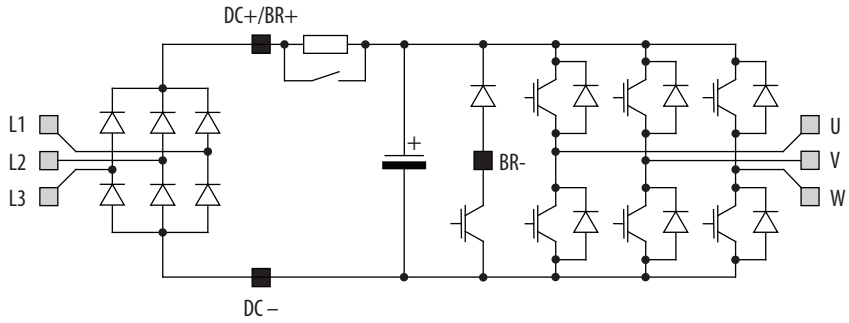
**Figure 4 - AC and DC Input Schematic for PowerFlex 40P Frame C AC Drives**



## PowerFlex 520-Series Frame A, B, and C AC Drives

For the PowerFlex 520-Series Frame A, B, and C AC drives, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the positive DC bus, between the diode bridge and the bus capacitors. The resistor has a relay contact connected in parallel that closes when the bus precharge level has been reached, bypassing the precharge resistor. The precharge function operates the same way for either AC or DC input power.

**Figure 5 - AC and DC Input Schematic for PowerFlex 520-Series Frame A, B, and C AC Drives**

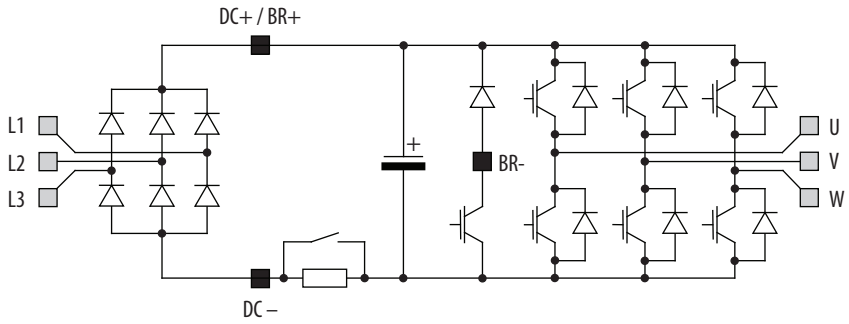



This schematic represents 3-phase input voltage PowerFlex 520-Series drives in the designated frame size.

## PowerFlex 520-Series Frame D AC Drives

For the PowerFlex 520-Series Frame D AC drives, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the negative DC bus, between the diode bridge and the bus capacitors. The resistor has a relay contact connected in parallel that closes when the bus precharge level has been reached, bypassing the precharge resistor. The precharge function operates the same way for either AC or DC input power.

**Figure 6 - AC and DC Input Schematic for PowerFlex 520-Series Frame D AC Drives**

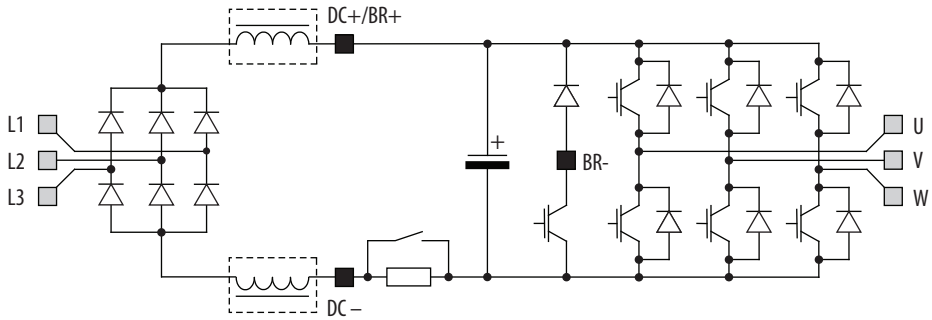



This schematic represents 3-phase input voltage PowerFlex 520-Series drives in the designated frame size.

## PowerFlex 520-Series Frame E AC Drives

For the PowerFlex 520-Series Frame E AC drives, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the negative DC bus, between the DC link inductor and the bus capacitors. The resistor has a relay contact connected in parallel that closes when the bus precharge level has been reached, bypassing the precharge resistor. The precharge function operates the same way for either AC or DC input power.

**Figure 7 - AC and DC Input Schematic for PowerFlex 520-Series Frame E AC Drives**

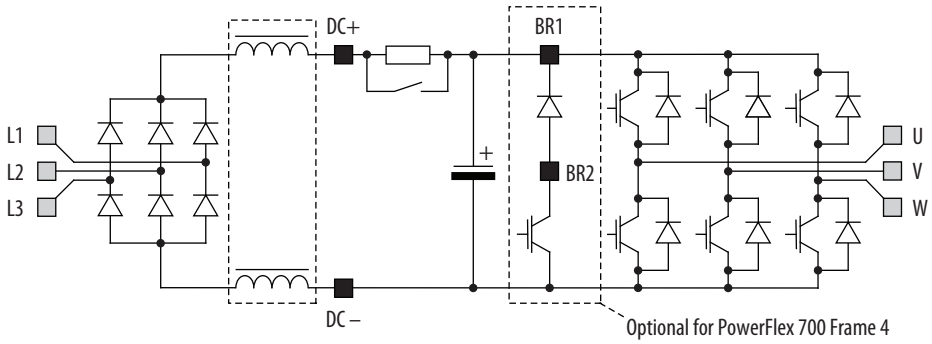



This schematic represents 3-phase input voltage PowerFlex 520-Series drives in the designated frame size.

## PowerFlex 70 Frame E, PowerFlex 700/700S Frame 0…4, and PowerFlex 750-Series Frame 1…4 AC Drives

For PowerFlex 70 Frame E, PowerFlex 700/700S Frame 0...4, and PowerFlex 750-Series Frame 1...4 AC drives, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the positive DC bus, between the DC link and the bus capacitors. The resistor has a relay contact connected in parallel that closes when the bus precharge level has been reached, bypassing the precharge resistor. The precharge function operates the same way for either AC or DC input power.

**Figure 8 - AC and DC Input Schematic for PowerFlex 70 Frame E, PowerFlex 700/700S Frame 0…4, and PowerFlex 750-Series Frame 1…4 AC Drives**

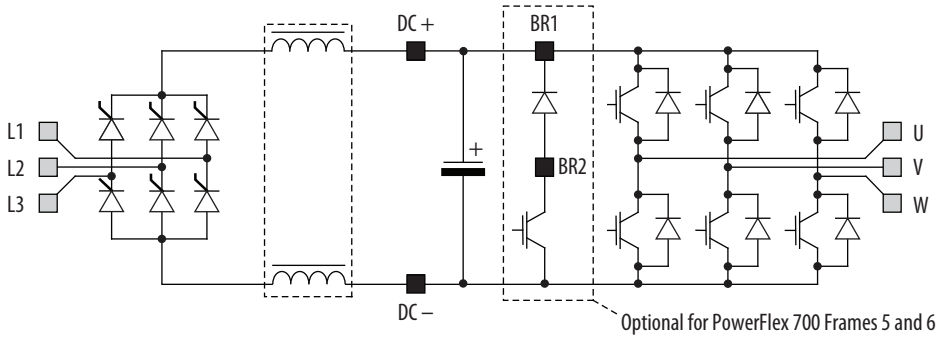


## PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7…10 AC Input 'Stand-alone' Drives

For PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7...10 drives (AC Input), the precharge function is implemented with an SCR rectifier such that the SCRs are phase advanced to limit the inrush current into the bus capacitors. This phase-advanced precharge is not controlled by the drive and must normally be completed by the minimum precharge time required by the drive. The drive does not complete precharge until the bus voltage is stable and above the under voltage level.

**ATTENTION:** PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7…10 AC input drives have no method for the user to control the precharge sequence. Never connect these drives to an energized DC bus. Severe drive and/or equipment damage can result due to an uncontrolled precharge of these drives.

**Figure 9 - AC Input Schematic for PowerFlex 700/700S Frame 5 and 6 (Voltage Rating Catalog Codes B, C, D, E, and F), and PowerFlex 700 Frame 7…10 AC Drives**

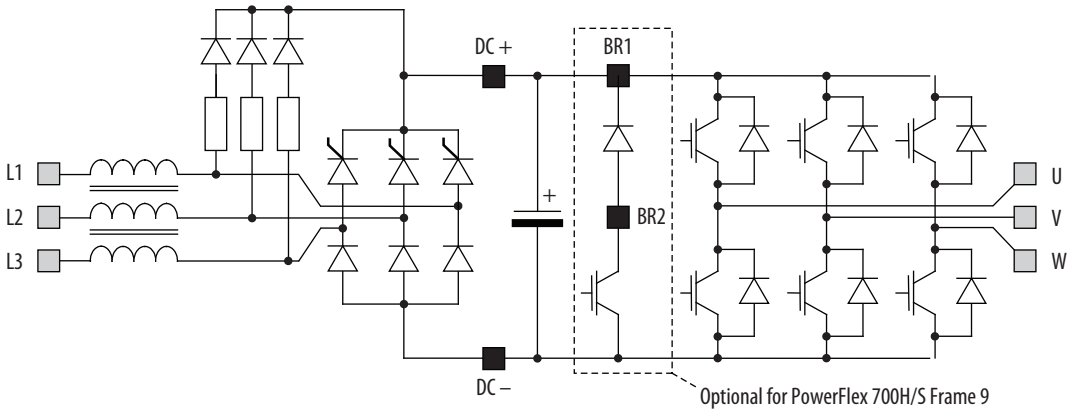



## PowerFlex 700H/700S Frame 9…14 AC Input 'Stand-alone' Drives

During the precharge phase of PowerFlex 700H/700S Frame 9...14 drives, the three SCR switches of the front end rectifier are open and the bus capacitors are charged through the resistors and diodes from the AC side of the bridge. After the DC bus has reached precharge level, the SCRs when turned on bypass the diode/resistor configuration.

**ATTENTION:** PowerFlex 700H/700S Frame 9…14 AC input drives have no method for the user to control the precharge sequence. Never connect these drives to an energized DC bus. Severe drive and/or equipment damage can result due to an uncontrolled precharge of these drives.

**Figure 10 - AC Input Schematic for PowerFlex 700H/700S Frame 9…14 AC Drives (Voltage Rating Catalog Codes B, C, D, E, and F)**

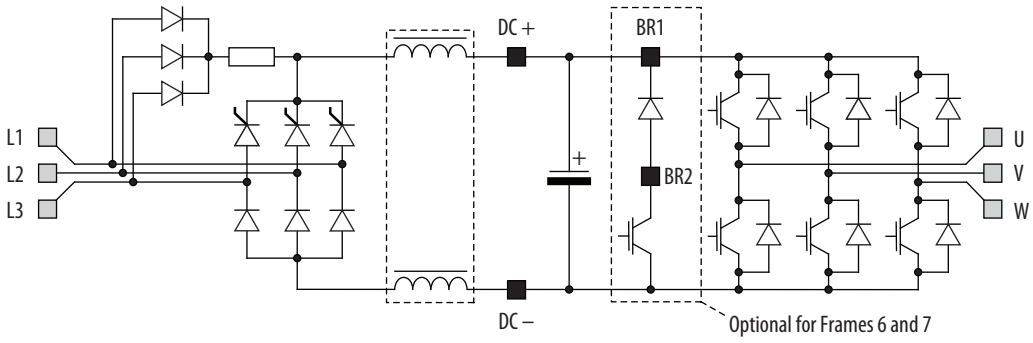



## PowerFlex 750-Series Frame 5…7 AC Drives

When ordered as an AC input drive, DC terminals are not provided on Frames 6 and 7. During precharge, the SCRs of the front end rectifier are open and the bus capacitors are charged through the diodes and resistors from the AC input. After the DC bus has reached precharge level, the SCRs when turned on bypass the diode resistor configuration.

**ATTENTION:** PowerFlex 750-Series Frame 5…7 AC input drives have no method for the user to control the precharge sequence. Never connect these drives to an energized DC bus. Severe drive and/or equipment damage can result due to an uncontrolled precharge of these drives.

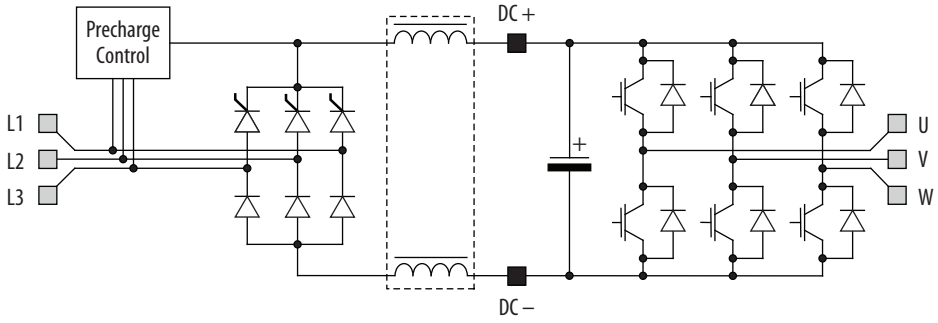
**Figure 11 - AC Input Schematic for PowerFlex 750-Series Frame 5…7 AC Drives (Voltage Rating Catalog Codes 1 and A)**



## PowerFlex 750-Series Frame 8…10 AC Input 'Stand-alone' Drives

For PowerFlex 750-Series Frame 8...10 AC input drives, the precharge function is implemented with a diode/SCR rectifier such that the SCRs are phase advanced to limit the inrush current into the bus capacitors. This phase-advanced precharge is controlled by a converter firing board within the drive and must normally be completed by the minimum precharge time required by the drive.

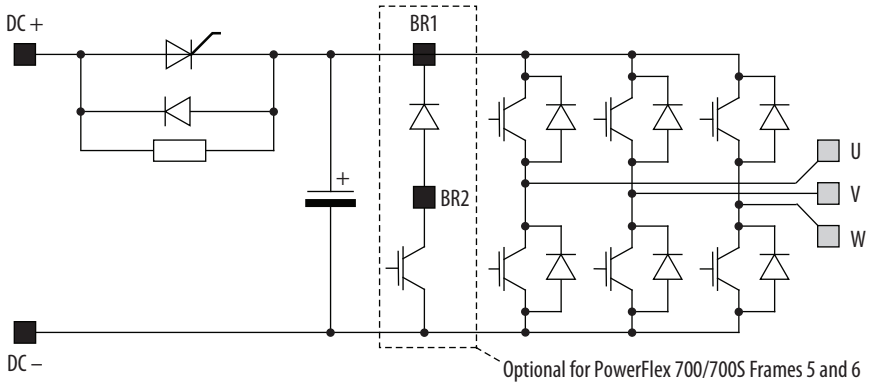
**Figure 12 - AC Input Schematic for PowerFlex 750-Series Frame 8…10 AC Drives (Voltage Rating Catalog Codes 1 and A)**




## PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7…10 DC Input 'Common Bus' Drives

There are two versions of these DC Input or common bus drives. One version has a resistor in series with the positive DC bus, ahead of the bus capacitors. An SCR is connected in parallel and when gated on, it bypasses the resistor. PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 7...9 drives are available with this internal precharge.

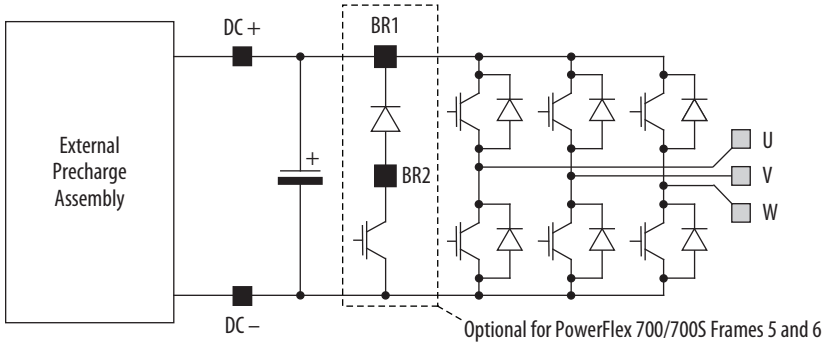
**Figure 13 - DC Input Schematic for PowerFlex 700/700S Frame 5 and 6 (Voltage Rating Catalog Codes N, P, R, T, and W), and PowerFlex 700 Frame 7…9 DC Input Drives**



PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 10 drives do not have an internal precharge option, which is intended for applications where the precharge hardware and control is provided by the user.

**ATTENTION:** PowerFlex 700/700S Frame 5 and 6, and PowerFlex 700 Frame 10 DC input drives have no method for the user to control the precharge sequence. Never connect these drives to an energized DC bus. Severe drive and/or equipment damage can result due to an uncontrolled precharge of these drives.

**Figure 14 - DC Input Schematic for PowerFlex 700/700S Frame 5 and 6 (Voltage Rating Catalog Codes H, J, K, and M), and PowerFlex 700 Frame 10 DC Input Drives**

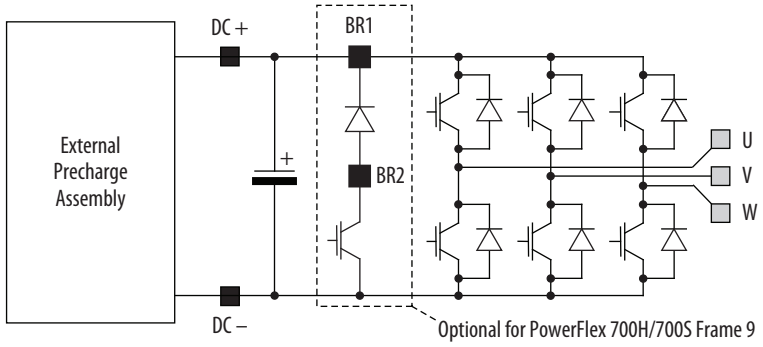



## PowerFlex 700H/700S Frame 9…14 DC Input 'Common Bus' Drives

PowerFlex 700H/700S Frame 9...14 drives (DC Input) do not include internal precharge. Precharge must be provided by an external precharge assembly.

**ATTENTION:** PowerFlex 700H/700S Frame 9…14 DC input drives have no method for the user to control the precharge sequence. Never connect these drives to an energized DC bus. Severe drive and/or equipment damage can result due to an uncontrolled precharge of these drives.

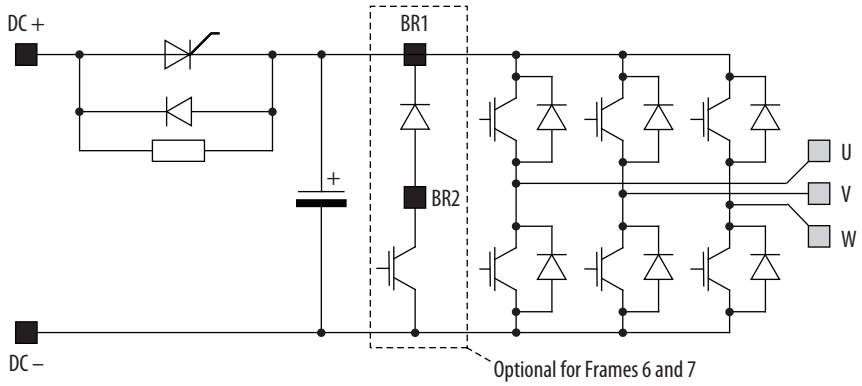
**Figure 15 - DC Input Schematic for PowerFlex 700H/700S Frame 9…14 DC Input Drives (Voltage Rating Catalog Codes H, J, K, and M)**



## PowerFlex 750-Series Frame 5…7 DC Input 'Common Bus' Drives

The precharge has a resistor in series with the positive DC bus, ahead of the bus capacitors. An SCR is connected in parallel and when gated on, it bypasses the resistor.

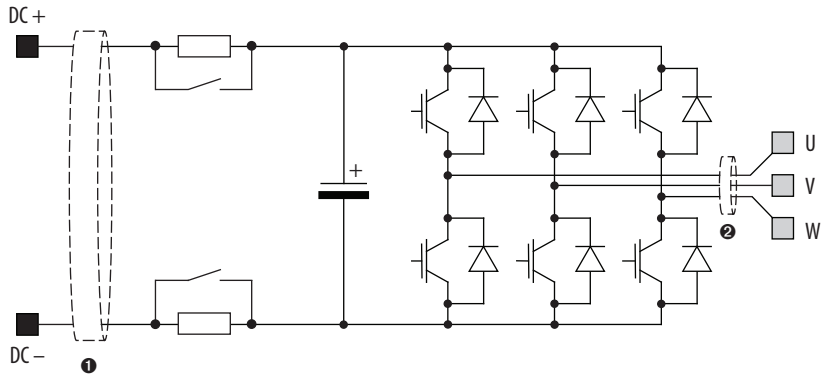
**Figure 16 - DC Input Schematic for PowerFlex 750-Series Frame 5…7 DC Input Drives (Input Type Catalog Code 4)**




## PowerFlex 750-Series Frame 8…10 DC Input 'Common Bus' Drives

For PowerFlex 750-Series Frame 8...10 DC input drives, the precharge function is implemented with a resistor and bypass contactor in both the positive and negative DC bus between the DC input and the bus capacitors. When the DC bus precharge level has been reached, the contactor closes bypassing the resistor.

**Figure 17 - DC Input Schematic for PowerFlex 750-Series Frame 8…10 DC Input Drives (Input Type Catalog Code 4)**




❶ A common mode core is included when ordering a Catalog No. 21G drive with a 'P' or 'W' enclosure. A Common Mode Core is also included with any of the following IP00 Input Termination kits:

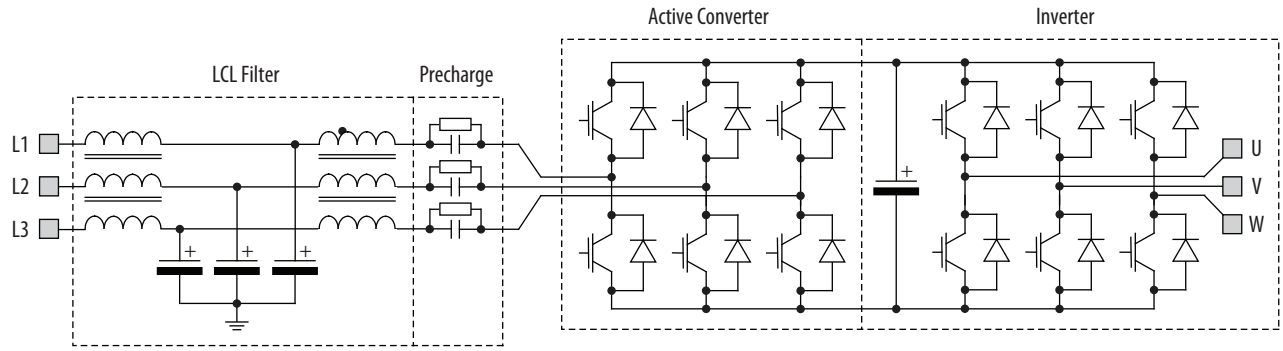
- 20-750-BUS5-F8
- 20-750-BUS5-F9
- 20-750-BUS5-F10

❷ A motor output common mode core is included in kit 20-750-EMCCM1-F8.

## PowerFlex 700L Frame 2, 3A, and 3B AC Input 'Stand-alone' Drives

PowerFlex 700L Frame 2, 3A, and 3B AC input drives are regenerative drives with an active converter and input filter. The precharge circuit is connected between the input filter and the active converter. This is a 3-phase precharge with resistors in parallel with AC contactors. When the precharge is complete, the AC contactors close to bypass the resistors.

**Figure 18 - AC Input Schematic for PowerFlex 700L Frame 2, 3A, and 3B AC Drives (Equipment Type Catalog Code A)**

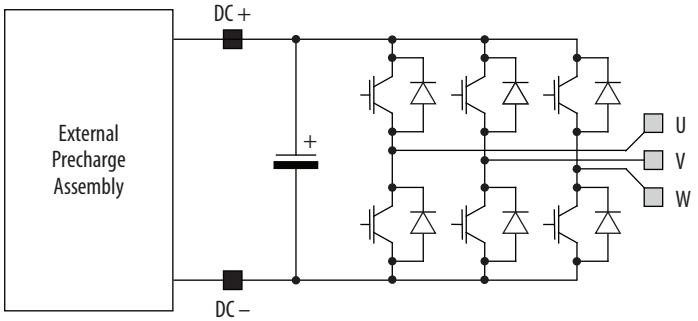



## PowerFlex 700L Frame 3A and 3B DC Input 'Common Bus' Drives

PowerFlex 700L Frame 3A and 3B drives (DC Input) do not include internal precharge. Precharge must be provided by an external precharge assembly.

**ATTENTION:** PowerFlex 700L Frame 3A and 3B DC input drives have no method for the user to control the precharge sequence. Never connect these drives to an energized DC bus. Severe drive and/or equipment damage can result due to an uncontrolled precharge of these drives.

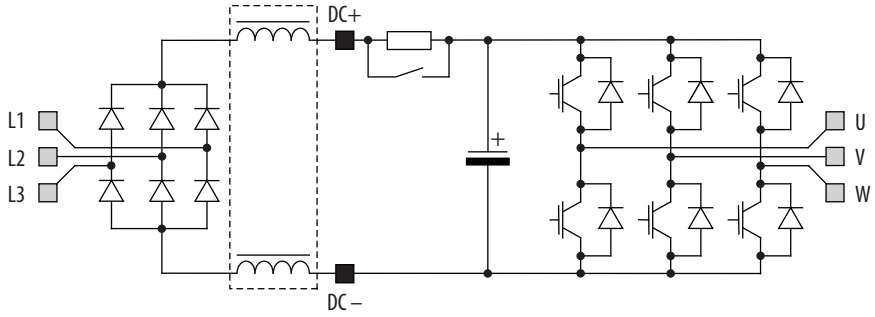
**Figure 19 - DC Input Schematic for PowerFlex 700L Frame 3A and 3B DC Input Drives (Equipment Type Catalog Codes K and L)**



## Kinetix 7000 Catalog Number BM06…BM08 Servo Drives

For Kinetix 7000 servo drives, catalog numbers BM06...BM08, the precharge hardware is located on the power circuit board. It is composed of a resistor in series with the positive DC bus between the DC link and the bus capacitors. The resistor has a relay contact connected in parallel that closes when the bus precharge level has been reached, bypassing the precharge resistor. The precharge function operates the same way for either AC or DC power.

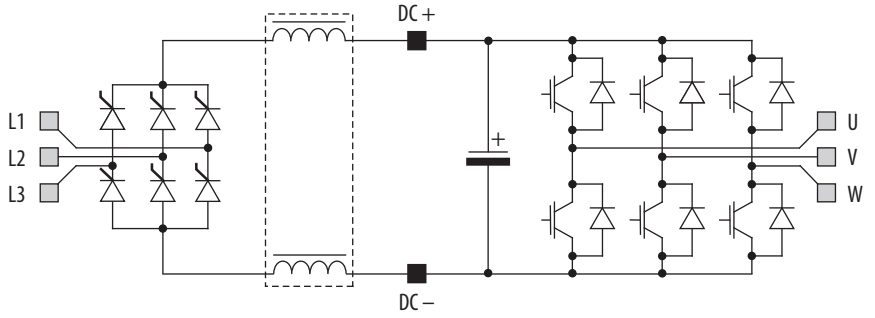
**Figure 20 - AC and DC Input Schematic for Kinetix 7000 BM06…BM08 Servo Drives**




## Kinetix 7000 Catalog Number BM09…BM12 Servo Drives

For Kinetix 7000 servo drives, catalog numbers BM09...BM12, the precharge hardware is implemented with an SCR rectifier such that the SCR's are phase advanced to limit the inrush current into the bus capacitors. This phase-advanced precharge is not controlled by the drive and must normally be completed by the minimum precharge time required by the drive. The drive does not complete precharge until the bus voltage is stable and above the undervoltage level.

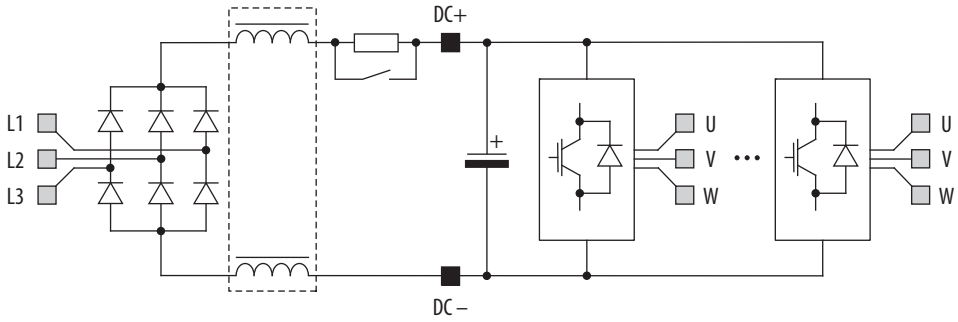
**Figure 21 - AC Input Schematic for Kinetix 7000 BM09…BM12 Servo Drives**



## Kinetix 6000 Bxxx-Series and Kinetix 6200/6500 Multi-Axis Servo Drives

The Kinetix 6000 series and Kinetix 6200/6500 series is a packaged, highly configurable, common bus product with one converter module and multiple inverter modules mounted on a shared backplane. Precharge hardware, which consists of a resistor in series with a DC link inductor and the positive rail of the DC bus, is mounted in the converter module. In all recommended common bus configurations with PowerFlex drives, the converter is not used; therefore, three phase AC power should never be connected to the converter in mixed PowerFlex/Kinetix 6000 common bus configurations. An internal shunt module (braking chopper) is built into each inverter module. To be used in a common bus system with PowerFlex drives, the Kinetix system must be set to the common-bus follower condition with the shunt modules disabled.

**Figure 22 - System Schematic for Kinetix 6000 Bxxx-Series and Kinetix 6200/6500 Multi-Axis Servo Drives**



# Common DC Bus Configuration—Non-Regenerative

## System Characteristics

This system is characterized by a diode, an SCR rectifier front end, or a combination of these two, which converts the 3-phase AC line voltage into a non-filtered DC bus voltage. No provisions exist for line regeneration or power dissipation of any recovered energy from the motor/load system.

## Supported Products

At the time of publication, the following non-regenerative DC Bus Supplies and PowerFlex drives are supported.

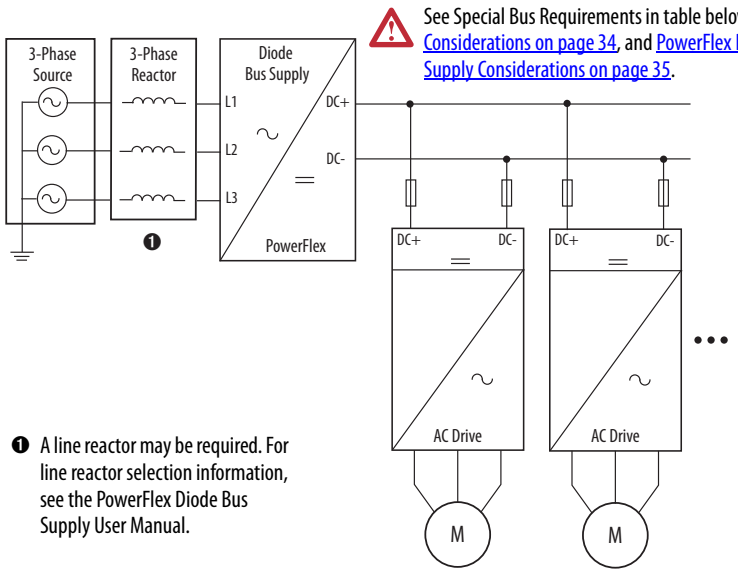
| DC Bus Supply Products | Supported Drives |
|---|---|
| PowerFlex Diode Bus Supply 20T | PowerFlex 40P: All power ratings |
| | PowerFlex 520-Series: All power ratings - Three phase only |
| | PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…4 |
| | PowerFlex 700S: Frames 1…4 (2) |
| | PowerFlex 750-Series: Frames 1…4 |
| | Kinetix 7000: BM06…BM08 |
| PowerFlex SCR Bus Supply 20S | PowerFlex 40P: All power ratings |
| | PowerFlex 520-Series: All power ratings - Three phase only |
| | PowerFlex 700 (1) / PowerFlex 700 Series B (1): All frame sizes (3) |
| | PowerFlex 700S: All frame sizes (3) |
| | PowerFlex 700H: All frame sizes (3) |
| | PowerFlex 700L: Frames 3A (4) and 3B (3) |
| | PowerFlex 750-Series: Frames 1…10 (5) |
| | Kinetix 7000: All power ratings |
| | Kinetix 6000 and Kinetix 6200/6500: All 460V configurations (6) |

(1) These drives require firmware revision 2.001 or later (Standard and Vector Control).
(2) There is no Frame 0 for PowerFlex 700S drives.
(3) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.
(4) Frame 3A dual inverter drives only.
(5) PowerFlex 750-Series Frame 5…10 DC input version drives with precharge must be selected.
(6) Kinetix 6000 configurations require firmware revision 1.92 or later.

# Typical System Configuration

## PowerFlex Diode Bus Supply

**Figure 23 - Diode Bus Supply with Stand-alone AC Drives Connected in Common Bus Configuration**

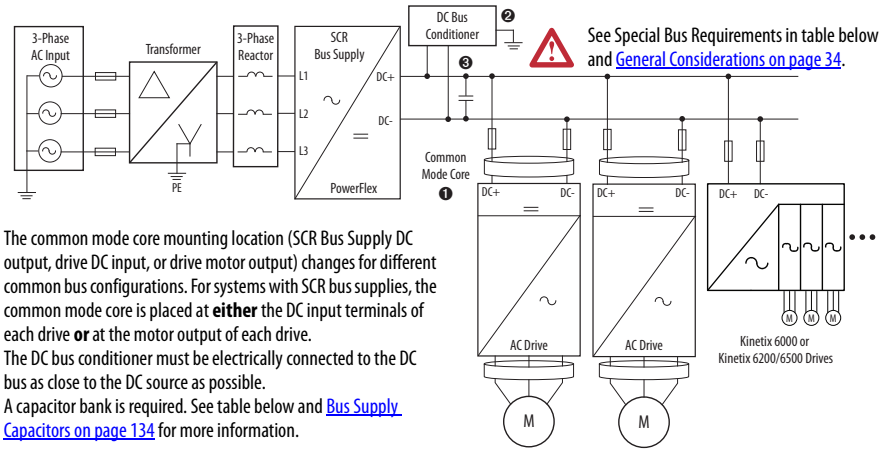



❶ A line reactor may be required. For line reactor selection information, see the PowerFlex Diode Bus Supply User Manual.

| Drawing Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive | PowerFlex 700/700S: Frames 0…4 | None |
| | PowerFlex 750-Series: Frames 1…4 | None |
| | Kinetix 7000: BM06…BM08 | None |
| | PowerFlex 40P: All power ratings | **Important:** Do not use PowerFlex 40P or PowerFlex 520-Series drives on the same DC bus supply with PowerFlex 700/700S/750-Series drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P or PowerFlex 520-Series drives compared to the PowerFlex 700/700S/750-Series drives and Kinetix 7000 drives. |
| | PowerFlex 520-Series: All power ratings - Three phase only | |

# PowerFlex SCR Bus Supply in Solid Ground System

**Figure 24 - SCR Bus Supply with Stand-alone AC Drives and Kinetix 6000 Drive System in a Common Bus Configuration**




❶ The common mode core mounting location (SCR Bus Supply DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with SCR bus supplies, the common mode core is placed at **either** the DC input terminals of each drive **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

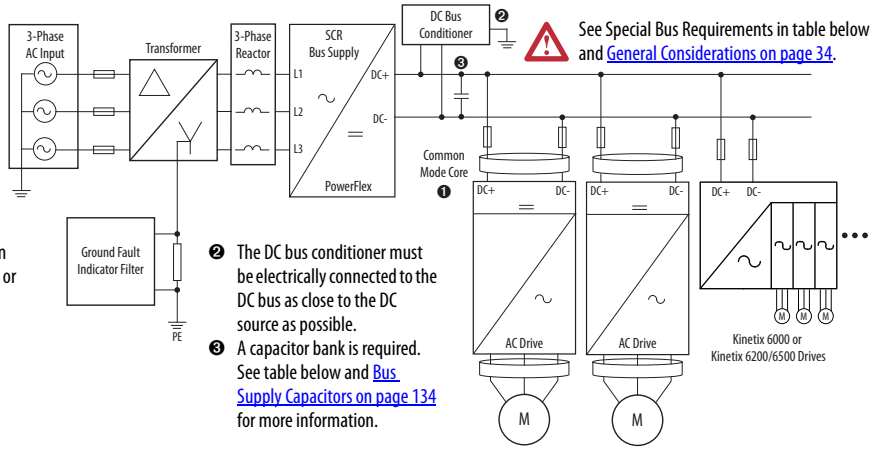
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| Drawing Designation | System Ground Type | Supported Drives | | Common Mode Core (9) | DC Bus Conditioner (11) |
|---|---|---|---|---|---|
| | | Voltage | Type | | |
| AC Drive | Solid | 400/480 | PowerFlex 700/700S: Frames 0…4 | N/A | Design D (12) |
| | | 600 | | N/A | Design C |
| | Solid | 400/480 | PowerFlex 700/700S: Frames 5 and 6 (1) (2) | N/A | Design D (12) |
| | | 600/690 | | N/A | Design C |
| | Solid | 400/480 | PowerFlex 700: Frames 7…10 (3) | Contact Factory (10) | |
| | | 600/690 | | | |
| | Solid | 400/480 | PowerFlex 700H/700S: Frames 9…14 (3) | Contact factory for 30339-319-01 | Design D (12) |
| | | 600/690 | | | Design C |
| | Solid | 400/480 | PowerFlex 700L: Frames 3A (3) (4) and 3B (3) | Contact Factory (10) | |
| | | 600/690 | | | |
| | Solid | 400/480 | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design G (12) |
| | | 600 | PowerFlex 750-Series: Frames 3 and 4 | | Design G |
| | Solid | 400/480 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frame 7<br>PowerFlex 750-Series: Frames 8…10 (5) (6) | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design G (12) |
| | | 600/690 | | | Design G |
| | Solid | 400/480 | Kinetix 7000: BM06…BM08 | Contact Factory (10) | |
| | Solid | 400/480 | Kinetix 7000: BM09…BM12 (7) | Contact Factory (10) | |
| Kinetix 6000 and Kinetix 6200/6500 | Solid | 400/480 | Kinetix 6000: Bxxx-Series (460V only) (8)<br>Kinetix 6200/6500 Multi-Axis Servo Drives (460V only) (8) | Contact Factory (10) | |

(1) Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. Also, DC input 'common bus' drives are required—not AC stand-alone configuration.
(2) At 600 volts, PowerFlex 700/700S Frame 5 and 6 drives cannot be used on the same bus as PowerFlex 700/700S Frame 0…4 drives.
(3) Additional bus capacitance may be required; see General Considerations on page 34. External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. DC input 'common bus' drives are required—not AC stand-alone configuration.
(4) Frame 3A dual inverter drives only.
(5) DC input version with precharge must be selected.
(6) At 600 volts, PowerFlex 750-Series Frame 6…10 drives cannot be used on the same bus as PowerFlex 750-Series Frame 3…5 drives.
(7) External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
(8) No internal precharge; see PowerFlex SCR Bus Supply Considerations on page 35. Drives must be placed in a common bus follower configuration.
(9) One common mode core is required for each drive. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(10) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(11) One DC bus conditioner is required for each PowerFlex SCR Bus Supply.
(12) Only for systems with more than 20 drives; otherwise not required.

# PowerFlex SCR Bus Supply in High Resistance Ground System

**Figure 25 - SCR Bus Supply with Stand-alone AC Drives and Kinetix 6000 Drive System in a Common Bus Configuration**




❶ The common mode core mounting location (SCR Bus Supply DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with SCR bus supplies, the common mode core is placed at **either** the DC input terminals of each drive **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

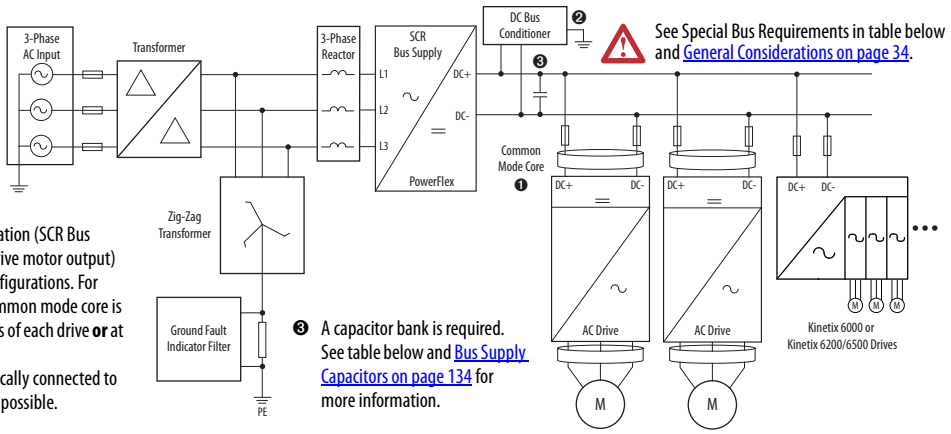
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| Drawing Designation | System Ground Type | Supported Drives | | Common Mode Core (9) | DC Bus Conditioner (11) | Gnd. Fault Indicator Filter (12) |
|---|---|---|---|---|---|---|
| | | Voltage | Type | | | |
| AC Drive | High Resistance Ground | 400/480 | PowerFlex 700/700S: Frames 0…4 | N/A | Design E | Yes |
| | | 600 | | N/A | Design E | |
| | High Resistance Ground | 400/480 | PowerFlex 700/700S: Frames 5 and 6 (1) (2) | N/A | Design E | Yes |
| | | 600/690 | | N/A | Design E | |
| | High Resistance Ground | 400/480 | PowerFlex 700: Frames 7…10 (3) | Contact Factory (10) | | |
| | | 600/690 | | | | |
| | High Resistance Ground | 400/480 | PowerFlex 700H/700S: Frames 9…14 (3) | Contact factory for 30339-319-01 | Design E | Yes |
| | | 600/690 | | | Design E | |
| | High Resistance Ground | 400/480 | PowerFlex 700L: Frames 3A (3) (4) and 3B (3) | Contact Factory (10) | | |
| | | 600/690 | | | | |
| | High Resistance Ground | 400/480 | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design E | Yes |
| | | 600 | PowerFlex 750-Series: Frames 3 and 4 | | Design E | |
| | High Resistance Ground | 400/480 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frame 7<br>PowerFlex 750-Series: Frames 8…10 (5) (6) | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes |
| | | 600/690 | | | Design E | |
| | High Resistance Ground | 400/480 | Kinetix 7000: BM06…BM08 | Contact Factory (10) | | |
| | High Resistance Ground | 400/480 | Kinetix 7000: BM09…BM12 (7) | Contact Factory (10) | | |
| Kinetix 6000 and Kinetix 6200/6500 | High Resistance Ground | 400/480 | Kinetix 6000: Bxxx-Series (460V only) (8)<br>Kinetix 6200/6500 Multi-Axis Servo Drives (460V only) (8) | Contact Factory (10) | | |

(1) Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. Also, DC input 'common bus' drives are required—not AC stand-alone configuration.
(2) At 600 volts, PowerFlex 700/700S Frame 5 and 6 drives cannot be used on the same bus as PowerFlex 700/700S Frame 0…4 drives.
(3) Additional bus capacitance may be required; see General Considerations on page 34. External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. DC input 'common bus' drives are required—not AC stand-alone configuration.
(4) Frame 3A dual inverter drives only.
(5) DC input version with precharge must be selected.
(6) At 600 volts, PowerFlex 750-Series Frame 6…10 drives cannot be used on the same bus as PowerFlex 750-Series Frame 3…5 drives.
(7) External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
(8) No internal precharge; see PowerFlex SCR Bus Supply Considerations on page 35. Drives must be placed in a common bus follower configuration.
(9) One common mode core is required for each drive. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(10) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(11) One DC bus conditioner is required for each PowerFlex SCR Bus Supply.
(12) See Ground Fault Indicator Filter on page 143 for recommendations.

# PowerFlex SCR Bus Supply in Ungrounded System

**Figure 26 - SCR Bus Supply with Stand-alone AC Drives and Kinetix 6000 Drive System in a Common Bus Configuration**




❶ The common mode core mounting location (SCR Bus Supply DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with SCR bus supplies, the common mode core is placed at **either** the DC input terminals of each drive **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| Drawing Designation | System Ground Type | Supported Drives | | Common Mode Core (9) | DC Bus Conditioner (11) | Gnd. Fault Indicator Filter (12) | Zig Zag Transformer Required (13) |
|---|---|---|---|---|---|---|---|
| | | Voltage | Type | | | | |
| AC Drive | Ungrounded | 400/480 | PowerFlex 700/700S: Frames 0…4 | N/A | Design E | Yes | Yes |
| | | 600 | | N/A | Design E | | |
| | Ungrounded | 400/480 | PowerFlex 700/700S: Frames 5 and 6 (1) (2) | N/A | Design E | Yes | Yes |
| | | 600/690 | | N/A | Design E | | |
| | Ungrounded | 400/480 | PowerFlex 700: Frames 7…10 (3) | Contact Factory (10) | | | |
| | | 600/690 | | | | | |
| | Ungrounded | 400/480 | PowerFlex 700H/700S: Frames 9…14 (3) | Contact factory for 30339-319-01 | Design E | Yes | Yes |
| | | 600/690 | | | Design E | | |
| | Ungrounded | 400/480 | PowerFlex 700L: Frames 3A (3) (4) and 3B (3) | Contact Factory (10) | | | |
| | | 600/690 | | | | | |
| | Ungrounded | 400/480 | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design E | Yes | Yes |
| | | 600 | PowerFlex 750-Series: Frames 3 and 4 | | Design E | | |
| | Ungrounded | 400/480 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frame 7<br>PowerFlex 750-Series: Frames 8…10 (5) (6) | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes | Yes |
| | | 600/690 | | | Design E | | |
| | Ungrounded | 400/480 | Kinetix 7000: BM06…BM08 | Contact Factory (10) | | | |
| | Ungrounded | 400/480 | Kinetix 7000: BM09…BM12 (7) | Contact Factory (10) | | | |
| Kinetix 6000 and Kinetix 6200/6500 | Ungrounded | 400/480 | Kinetix 6000: Bxxx-Series (460V only) (8)<br>Kinetix 6200/6500 Multi-Axis Servo Drives (460V only) (8) | Contact Factory (10) | | | |

(1) Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. Also, DC input 'common bus' drives are required—not AC stand-alone configuration.
(2) At 600 volts, PowerFlex 700/700S Frame 5 and 6 drives cannot be used on the same bus as PowerFlex 700/700S Frame 0…4 drives.
(3) Additional bus capacitance may be required; see General Considerations on page 34. External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. DC input 'common bus' drives are required—not AC stand-alone configuration.
(4) Frame 3A dual inverter drives only.
(5) DC input version with precharge must be selected.
(6) At 600 volts, PowerFlex 750-Series Frame 6…10 drives cannot be used on the same bus as PowerFlex 750-Series Frame 3…5 drives.
(7) External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
(8) No internal precharge; see PowerFlex SCR Bus Supply Considerations on page 35. Drives must be placed in a common bus follower configuration.
(9) One common mode core is required for each drive. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(10) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(11) One DC bus conditioner is required for each PowerFlex SCR Bus Supply.
(12) See Ground Fault Indicator Filter on page 143 for recommendations.
(13) See Zig-Zag Transformer on page 144 for recommendations.

## General Considerations

**ATTENTION:** The incorrect use or configuration of third party assemblies can result in reduced system reliability and drive damage.

1. All system components (Bus Supply, and PowerFlex and Kinetix Drives) must be selected for the same AC-line voltage.
2. A low inductance type DC bus must be used. See DC Bus Connections on page 15 for details.
3. Take every precaution to minimize the distance between drives and wire lengths. The mixture of different frame size drives in this arrangement can cause high ripple current in the smaller frame drives. In this case, place the larger power drives physically closer to the bus supply. This helps current sharing among the various drives on the bus.
4. If a disconnect switch between the common DC bus and the drive's input is used, an auxiliary contact on the disconnect switch must be connected to a digital input of the drive. The corresponding digital input must be set to 'PreCharge En'. This provides the proper precharge interlocking, guarding against possible damage to the drive when reconnecting the drive to an energized DC bus. Under this condition, the drives must have internal or externally-supplied precharge.

| Drive | Parameter | | Digital Input |
|---|---|---|---|
| | Number | Setting | |
| PowerFlex 40P | A051…A054 | 29 (PreCharge En) | 1…4 |
| PowerFlex 523 | t062…t066 | 30 (PreCharge En) | 2…6 |
| PowerFlex 525 | t062…t068 | 30 (PreCharge En) | 2…8 |
| PowerFlex 700 | 361…366 | 30 (PreCharge En) | 1…6 |
| PowerFlex 700L with vector control | | | |
| PowerFlex 700S | 825…830 | 30 (PreCharge En) | 1…6 |
| PowerFlex 700L with 700S control | | | |
| PowerFlex 700H | 361…366 | 30 (PreCharge En) | 1…6 |
| PowerFlex 750-Series | 189 [DI Precharge] | See Drive Programming Manual for programming information. | |

**ATTENTION:** The Kinetix family of drives have no external means of controlling the precharge; therefore, a DC disconnect must not be used.

5. If a drive from column A in the table below is mixed with a drive from column B, a capacitor bank is required. See Bus Supply Capacitors on page 134 for details.

| Column A Drives | Column B Drives |
|---|---|
| PowerFlex 700/700S: Frames 0…5<br>PowerFlex 750-Series: Frames 1…10<br>Kinetix 6000 and Kinetix 6200/6500<br>Kinetix 7000 | PowerFlex 700/700S: Frame 6<br>PowerFlex 700: Frames 8…10<br>PowerFlex 700H/700S: Frame 9 and up<br>PowerFlex 700L: All Frames |

6. PowerFlex 700 drives and PowerFlex 700 Series B drives must have firmware revision 2.001 or later (Standard and Vector Control).
7. For further assistance with this Common Bus configuration, contact the Rockwell Automation SupportPlus engineering team at: http://www.ab.com/support/abdrives/files/supportplus.pdf

## PowerFlex Diode Bus Supply Considerations

The Diode Bus Supply can only be used with PowerFlex 700/700S Frame 0...4 drives, PowerFlex 750-Series Frame 1...4 drives, Kinetix 7000 BM06...BM08 drives, PowerFlex 40P drives (all power ratings), or PowerFlex 520-Series (all power ratings). This is because the Diode Bus Supply does not include precharge. The precharge function must be provided by the drives.

**ATTENTION:** Never connect Kinetix 7000 BM09…BM12 drives, Kinetix 6000-Series drives, or Kinetix 6200/6500 drives to a PowerFlex Diode Bus Supply in common bus configuration because there is no controlled, current-limited precharge of the DC bus capacitors, resulting in drive damage.

## PowerFlex SCR Bus Supply Considerations

**ATTENTION:** The SCR Bus Supply includes precharge. The use of drives with precharge is not required **if and only if** power is removed and reconnected to the entire system, **and if** individual drives do not require to be isolated and reconnected to an energized bus through a disconnect switch. Failure to follow this recommendation results in drive damage.

1. To commission and test the SCR Bus Supply, a minimum capacitance is required. See Bus Supply Capacitors on page 134 for details.
2. AC line reactors for di/dt limitation and current sharing must be externally mounted for each PowerFlex SCR Bus Supply. See the PowerFlex SCR Bus Supply User Manual for line reactor information.

## Sizing

To avoid overloading the Bus Supply, the following requirements apply:

- The DC Input current sum (Normal Duty or Heavy Duty rating at 40 °C / 104 °F) of the connected drives must not exceed the continuous DC Bus output current rating of the Bus Supply.
- For the DC Input Current values of the drives, see the tables in Appendix A. In addition, the guidelines provided in the product documentation also apply.
- For Kinetix product ratings, see the Kinetix Motion Control Selection Guide, and the Kinetix 6000 and 7000 User Manuals and Installation Instructions.

### PowerFlex Diode Bus Supply

The following examples show maximum loading of the Diode Bus Supply.

a) Normal Duty ND

| DC Input Rating of Connected Drives | | | | Diode Bus Supply | |
|---|---|---|---|---|---|
| DC Voltage | ND Power | ND Currents | ND Current Sum | Rated Cont. DC Output Amps | AC Input Voltage |
| 540V | 30 + 22 = 52 kW | 61.9 + 47.5 A | 109.4 A | 120 A | 400V |
| 650V | 2 x 40 = 80 HP | 2 x 55.7 A | 111.4 A | 120 A | 480V |

b) Heavy Duty HD

| DC Input Rating of Connected Drives | | | | Diode Bus Supply | |
|---|---|---|---|---|---|
| DC Voltage | HD Power | HD Currents | HD Current Sum | Rated Cont. DC Output Amps | AC Input Voltage |
| 540V | 2 x 15 = 30 kW | 2 x 40.9 A | 81.8 A | 120 A | 400V |
| 650V | 2 x 25 HP = 50 HP | 2 x 42.9 A | 85.8 A | 120 A | 480V |

Total the DC Input currents for all drives connected to the DC bus. This total must be less than 120A.

### PowerFlex SCR Bus Supply

The following examples show maximum loading of the SCR Bus Supply.

a) Normal Duty ND, 110%, 1 minute; 150%, 3 seconds

| DC Input Rating of Connected Drives | | | | SCR Bus Supply (1) | |
|---|---|---|---|---|---|
| DC Voltage | ND Power | ND Currents | ND Current Sum | Maximum DC Output Amps | AC Input Voltage |
| 540V | 3 x 110 kW<br>1 x 45 kW | 3 x 226 = 678 A<br>1 x 95 = 95 A | 773 A | 1000 A | 400V |
| 650V | 3 x 60 HP<br>1 x 30 HP | 3 x 84.5 = 253.5 A<br>1 x 42.9 = 42.9 A | 297 A | 400 A | 480V |

(1) No overload capability.

b) Heavy Duty HD, 150%, 1 minute; 200%, 3 seconds

| DC Input Rating of Connected Drives | | | | SCR Bus Supply (1) | |
|---|---|---|---|---|---|
| DC Voltage | HD Power | HD Currents | HD Current Sum | Maximum DC Output Amps | AC Input Voltage |
| 540V | 3 x 90 kW | 3 x 192.3 A = 577 A | 577 A | 600 A | 400V |
| 650V | 3 x 125 HP | 3 x 171 A = 513 A | 513 A | 600A | 480V |

(1) No overload capability.

## Fusing

### DC Input Drives

See Appendix A for the recommended Common DC Bus drive fusing.

### PowerFlex Diode Bus Supply

See the PowerFlex Diode Bus Supply User Manual for recommended AC input fusing.

### PowerFlex SCR Bus Supply

The PowerFlex SCR Bus Supply has built-in AC line and DC bus fuses (on 400A and 600A units). The 1000A unit has six in-path fuses which simultaneously protect AC and DC paths. All units are equipped with fuse trip indicator switches. See the PowerFlex SCR Bus Supply User Manual for fusing information.

## Notes:

# Common DC Bus Configuration—Non-Regenerative with Braking DC Bus Regulation

## System Characteristics

This system is characterized by a diode, an SCR rectifier front end, or a combination of these two, which converts the 3-phase AC line voltage into a non-filtered DC bus voltage. This system uses a Braking Chopper, Dynamic Brake Unit, or the drive's internal IGBT with a braking resistor for power dissipation of excess regenerative energy. Rockwell Automation does not offer external braking products. Please contact our Encompass Partners for these braking products.

## Supported Products

At the time of publication, these non-regenerative DC Bus Supplies and drives are supported.

| DC Bus Supply Products (1) | Supported Drives |
|---|---|
| PowerFlex Diode Bus Supply 20T | PowerFlex 40P: All power ratings |
| | PowerFlex 520-Series: All power ratings - Three phase only |
| | PowerFlex 700 (2) / PowerFlex 700 Series B (2): Frames 0…4 |
| | PowerFlex 700S: Frames 1…4 (3) |
| | PowerFlex 750-Series: Frames 1…4 |
| | Kinetix 7000: BM06…BM08 |
| PowerFlex SCR Bus Supply 20S | PowerFlex 40P: All power ratings |
| | PowerFlex 520-Series: All power ratings - Three phase only |
| | PowerFlex 700 (2) / PowerFlex 700 Series B (2): All frame sizes (4) |
| | PowerFlex 700S: All frame sizes (4) |
| | PowerFlex 700H: All frame sizes (4) |
| | PowerFlex 700L: Frame 3A (5) and 3B (4) |
| | PowerFlex 750-Series: Frames 1…10 (6) |
| | Kinetix 7000: All power ratings |
| | Kinetix 6000 and Kinetix 6200/6500: All 460V configurations (7) |

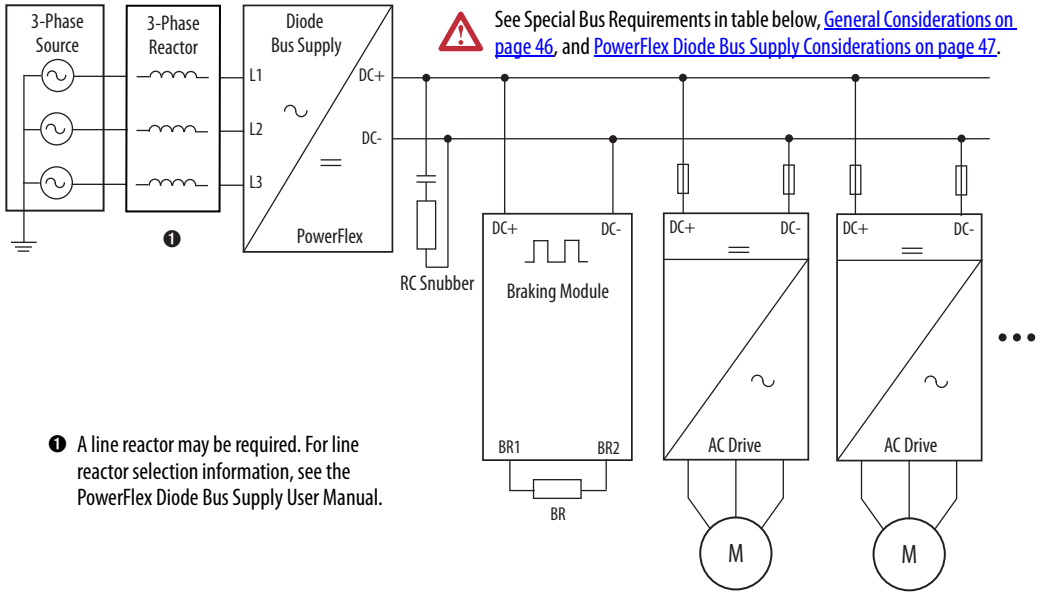
(1) For Bus Supply product details, see Chapter 2.
(2) These drives require firmware revision 2.001 or later (Standard and Vector Control).
(3) There is no Frame 0 for PowerFlex 700S drives.
(4) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.
(5) Frame 3A dual inverter drives only.
(6) PowerFlex 750-Series Frame 5…10 DC input version drives with precharge must be selected.
(7) Kinetix 6000 configurations require firmware revision 1.92 or later.

# Typical System Configurations

## Brake Chopper Modules

### *Diode Bus Supply*

**Figure 27 - Diode Bus Supply with Stand-alone AC Drives and Brake Chopper**

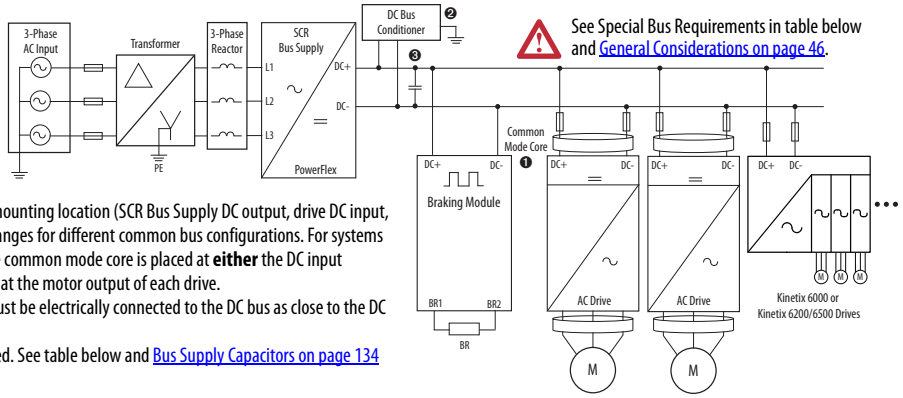



❶ A line reactor may be required. For line reactor selection information, see the PowerFlex Diode Bus Supply User Manual.

| Drawing Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive | PowerFlex 700/700S: Frames 0…4 | An RC snubber is required to limit DC bus voltage overshoot at power-on. See RC Snubber Circuit on page 136 for more information. |
| | PowerFlex 750-Series: Frames 1…4 | |
| | Kinetix 7000: BM06…BM08 | |
| | PowerFlex 40P: All power ratings | **Important:** Do not use PowerFlex 40P or PowerFlex 520-Series drives on the same DC bus supply with PowerFlex 700/700S/750-Series drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P or PowerFlex 520-Series drives compared to the PowerFlex 700/700S/750-Series drives and Kinetix 7000 drives. |
| | PowerFlex 520-Series: All power ratings - Three phase only | |

## *SCR Bus Supply in Solid Ground System*

**Figure 28 - SCR Bus Supply with Stand-alone AC Drives, Kinetix 6000 Drive System, and Braking Module**




❶ The common mode core mounting location (SCR Bus Supply DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with SCR bus supplies, the common mode core is placed at **either** the DC input terminals of each drive **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

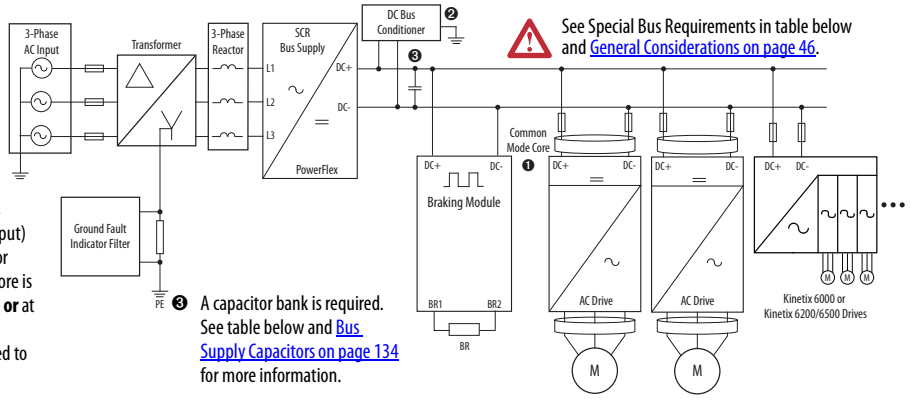
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| Drawing Designation | System Ground Type | Supported Drives/Products | | Common Mode Core (10) | DC Bus Conditioner (12) |
|---|---|---|---|---|---|
| | | Voltage | Type | | |
| AC Drive | Solid | 400/480 | PowerFlex 700/700S: Frames 0…4 | N/A | Design D (13) |
| | | 600 | | N/A | Design C |
| | Solid | 400/480 | PowerFlex 700/700S: Frames 5 and 6 (1) (2) | N/A | Design D (13) |
| | | 600/690 | | N/A | Design C |
| | Solid | 400/480 | PowerFlex 700: Frames 7…10 (3) | Contact Factory (11) | |
| | | 600/690 | | | |
| | Solid | 400/480 | PowerFlex 700H/700S: Frames 9…14 (3) | Contact factory for 30339-319-01 | Design D (13) |
| | | 600/690 | | | Design C |
| | Solid | 400/480 | PowerFlex 700L: Frames 3A (3) (4) and 3B (3) | Contact Factory (11) | |
| | | 600/690 | | | |
| | Solid | 400/480 | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design G (13) |
| | | 600 | PowerFlex 750-Series: Frames 3 and 4 | | Design G |
| | Solid | 400/480 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frame 7<br>PowerFlex 750-Series: Frames 8…10 (5) (6) | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design G (13) |
| | | 600/690 | | | Design G |
| | Solid | 400/480 | Kinetix 7000: BM06…BM08 | Contact Factory (11) | |
| | Solid | 400/480 | Kinetix 7000: BM09…BM12 (7) | Contact Factory (11) | |
| Kinetix 6000 and Kinetix 6200/6500 | Solid | 400/480 | Kinetix 6000 (460V only): Bxxx-Series (8)<br>Kinetix 6200/6500 Multi-Axis Servo Drives (460V only) (8) | Contact Factory (11) | |
| Braking Module | Solid | — | Encompass Partner product (9) | N/A | N/A |

(1) Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. DC input 'common bus' drives are required—not AC stand-alone configurations.
(2) At 600 volts, PowerFlex 700/700S Frame 5 and 6 drives cannot be used on the same bus as PowerFlex 700/700S Frame 0…4 drives.
(3) Additional bus capacitance may be required; see General Considerations on page 46. External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. DC input 'common bus' drives are required—not AC stand-alone configuration.
(4) Frame 3A dual inverter drives only.
(5) DC input version with precharge must be selected.
(6) At 600 volts, PowerFlex 750-Series Frame 6…10 drives cannot be used on the same bus as PowerFlex 750-Series Frame 3…5 drives.
(7) External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
(8) No internal precharge; see PowerFlex SCR Bus Supply Considerations on page 48. Drives must be placed in a common bus follower configuration.
(9) See PowerFlex SCR Bus Supply Considerations on page 48. If the instantaneous Brake Chopper current is larger than 150% of the DC input rating of the largest drive, a capacitor bank is required.
(10) One common mode core is required for each drive. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(11) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(12) One DC bus conditioner is required for each PowerFlex SCR Bus Supply.
(13) Only for systems with more than 20 drives; otherwise not required.

## *SCR Bus Supply in High Resistance Ground System*

**Figure 29 - SCR Bus Supply with Stand-alone AC Drives, Kinetix 6000 Drive System, and Braking Module**




❶ The common mode core mounting location (SCR Bus Supply DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with SCR bus supplies, the common mode core is placed at **either** the DC input terminals of each drive **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

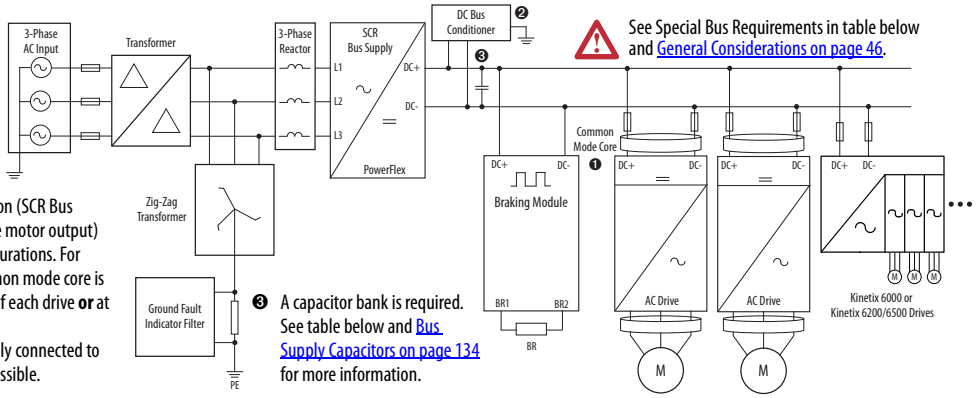
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| Drawing Designation | System Ground Type | Supported Drives/Products | | Common Mode Core (10) | DC Bus Conditioner (12) | Gnd. Fault Indicator Filter (13) |
|---|---|---|---|---|---|---|
| | | Voltage | Type | | | |
| AC Drive | High Resistance Ground | 400/480 | PowerFlex 700/700S: Frames 0…4 | N/A | Design E | Yes |
| | | 600 | | N/A | Design E | |
| | High Resistance Ground | 400/480 | PowerFlex 700/700S: Frames 5 and 6 (1) (2) | N/A | Design E | Yes |
| | | 600/690 | | N/A | Design E | |
| | High Resistance Ground | 400/480 | PowerFlex 700: Frames 7…10 (3) | Contact Factory (11) | | |
| | | 600/690 | | | | |
| | High Resistance Ground | 400/480 | PowerFlex 700H/700S: Frames 9…14 (3) | Contact factory for 30339-319-01 | Design E | Yes |
| | | 600/690 | | | Design E | |
| | High Resistance Ground | 400/480 | PowerFlex 700L: Frames 3A (3) (4) and 3B (3) | Contact Factory (11) | | |
| | | 600/690 | | | | |
| | High Resistance Ground | 400/480 | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design E | Yes |
| | | 600 | PowerFlex 750-Series: Frames 3 and 4 | | Design E | |
| | High Resistance Ground | 400/480 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frame7<br>PowerFlex 750-Series: Frames 5…10 (5) (6) | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes |
| | | 600/690 | | | Design E | |
| | High Resistance Ground | 400/480 | Kinetix 7000: BM06…BM08 | Contact Factory (11) | | |
| | High Resistance Ground | 400/480 | Kinetix 7000: BM09…BM12 (7) | Contact Factory (11) | | |
| Kinetix 6000 and Kinetix 6200/6500 | High Resistance Ground | 400/480 | Kinetix 6000 (460V only): Bxxx-Series (8)<br>Kinetix 6200/6500 Multi-Axis Servo Drives (460V only) (8) | Contact Factory (11) | | |
| Braking Module | High Resistance Ground | — | Encompass Partner product (9) | N/A | N/A | N/A |

(1) Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. DC input 'common bus' drives are required—not AC stand-alone configurations.
(2) At 600 volts, PowerFlex 700/700S Frame 5 and 6 drives cannot be used on the same bus as PowerFlex 700/700S Frame 0…4 drives.
(3) Additional bus capacitance may be required; see General Considerations on page 46. External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. DC input 'common bus' drives are required—not AC stand-alone configuration.
(4) Frame 3A dual inverter drives only.
(5) DC input version with precharge must be selected.
(6) At 600 volts, PowerFlex 750-Series Frame 6…10 drives cannot be used on the same bus as PowerFlex 750-Series Frame 3…5 drives.
(7) External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
(8) No internal precharge; see PowerFlex SCR Bus Supply Considerations on page 48. Drives must be placed in a common bus follower configuration.
(9) See PowerFlex SCR Bus Supply Considerations on page 48. If the instantaneous Brake Chopper current is larger than 150% of the DC input rating of the largest drive, a capacitor bank is required.
(10) One common mode core is required for each drive. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(11) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(12) One DC bus conditioner is required for each PowerFlex SCR Bus Supply.
(13) See Ground Fault Indicator Filter on page 143 for recommendations.

## *SCR Bus Supply in Ungrounded System*

**Figure 30 - SCR Bus Supply with Stand-alone AC Drives, Kinetix 6000 Drive System, and Braking Module**




❶ The common mode core mounting location (SCR Bus Supply DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with SCR bus supplies, the common mode core is placed at **either** the DC input terminals of each drive **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

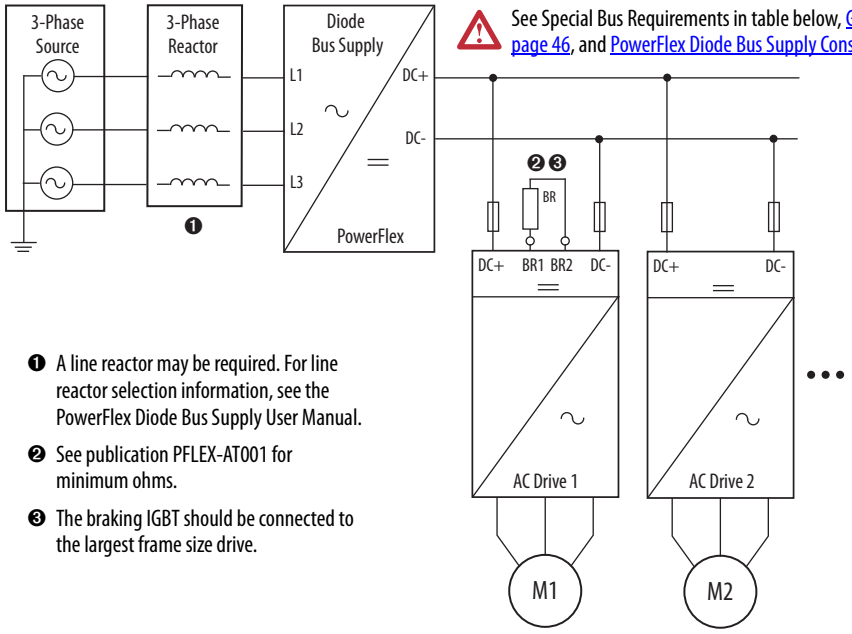
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| Drawing Designation | System Ground Type | Supported Drives/Products | | Common Mode Core (10) | DC Bus Conditioner (12) | Gnd. Fault Indicator Filter (13) | Zig Zag Transformer Required (14) |
|---|---|---|---|---|---|---|---|
| | | Voltage | Type | | | | |
| AC Drive | Ungrounded | 400/480 | PowerFlex 700/700S: Frames 0…4 | N/A | Design E | Yes | Yes |
| | | 600 | | N/A | Design E | | |
| | Ungrounded | 400/480 | PowerFlex 700/700S: Frames 5 and 6 (1) (2) | N/A | Design E | Yes | Yes |
| | | 600/690 | | N/A | Design E | | |
| | Ungrounded | 400/480 | PowerFlex 700: Frames 7…10 (3) | Contact Factory (11) | | | |
| | | 600/690 | | | | | |
| | Ungrounded | 400/480 | PowerFlex 700H/700S: Frames 9…14 (3) | Contact factory for 30339-319-01 | Design E | Yes | Yes |
| | | 600/690 | | | Design E | | |
| | Ungrounded | 400/480 | PowerFlex 700L: Frames 3A (3) (4) and 3B (3) | Contact Factory (11) | | | |
| | | 600/690 | | | | | |
| | Ungrounded | 400/480 | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design E | Yes | Yes |
| | | 600 | PowerFlex 750-Series: Frames 3 and 4 | | Design E | | |
| | Ungrounded | 400/480 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frame 7<br>PowerFlex 750-Series: Frames 8…10 (5) (6) | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes | Yes |
| | | 600/690 | | | Design E | | |
| | Ungrounded | 400/480 | Kinetix 7000: BM06…BM08 | Contact Factory (11) | | | |
| | Ungrounded | 400/480 | Kinetix 7000: BM09…BM12 (7) | Contact Factory (11) | | | |
| Kinetix 6000 and Kinetix 6200/6500 | Ungrounded | 400/480 | Kinetix 6000 (460V only): Bxxx-Series (8)<br>Kinetix 6200/6500 Multi-Axis Servo Drives (460V only) (8) | Contact Factory (11) | | | |
| Braking Module | Ungrounded | — | Encompass Partner product (9) | N/A | N/A | N/A | N/A |

(1) Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used. DC input 'common bus' drives are required—not AC stand-alone configurations.
(2) At 600 volts, PowerFlex 700/700S Frame 5 and 6 drives cannot be used on the same bus as PowerFlex 700/700S Frame 0…4 drives.
(3) Additional bus capacitance may be required; see General Considerations on page 46. External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. DC input 'common bus' drives are required—not AC stand-alone configuration.
(4) Frame 3A dual inverter drives only.
(5) DC input version with precharge must be selected.
(6) At 600 volts, PowerFlex 750-Series Frame 6…10 drives cannot be used on the same bus as PowerFlex 750-Series Frame 3…5 drives.
(7) External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.
(8) No internal precharge; see PowerFlex SCR Bus Supply Considerations on page 48. Drives must be placed in a common bus follower configuration.
(9) See PowerFlex SCR Bus Supply Considerations on page 48. If the instantaneous Brake Chopper current is larger than 150% of the DC input rating of the largest drive, a capacitor bank is required.
(10) One common mode core is required for each drive. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(11) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(12) One DC bus conditioner is required for each PowerFlex SCR Bus Supply.
(13) See Ground Fault Indicator Filter on page 143 for recommendations.
(14) See Zig-Zag Transformer on page 144 for recommendations.

## Drive Internal Brake IGBT

**Figure 31 - Diode Bus Supply with Stand-alone AC Drives with Internal Brake IGBT**




See Special Bus Requirements in table below, General Considerations on page 46, and PowerFlex Diode Bus Supply Considerations on page 47.

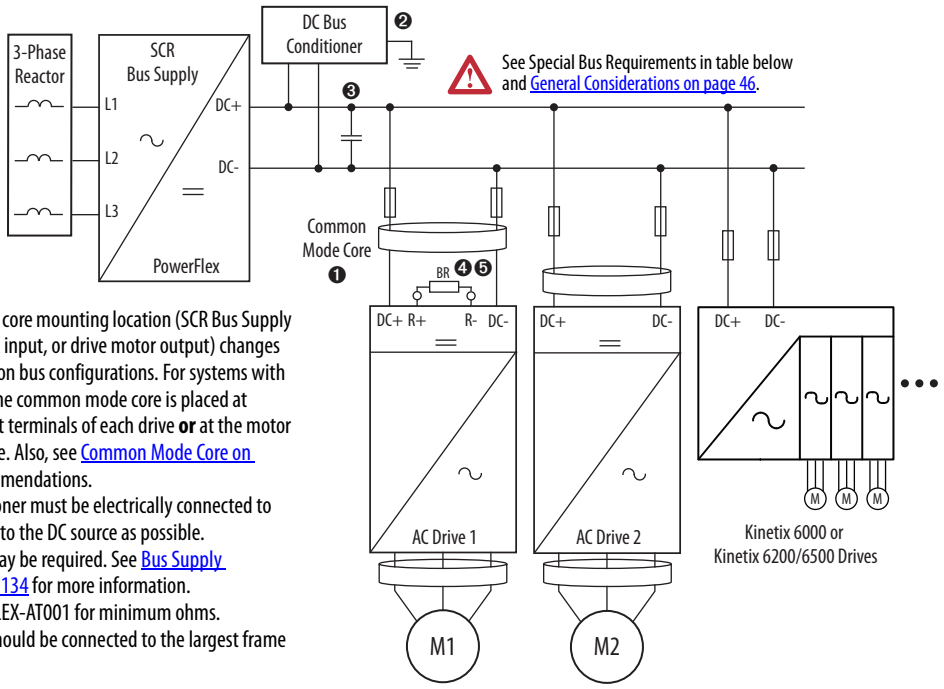
❶ A line reactor may be required. For line reactor selection information, see the PowerFlex Diode Bus Supply User Manual.

❷ See publication PFLEX-AT001 for minimum ohms.

❸ The braking IGBT should be connected to the largest frame size drive.

| Drawing Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive 1 | PowerFlex 700/700S: Frames 0…4 | None |
| | PowerFlex 750-Series: Frames 1…4 | None |
| | PowerFlex 40P: All power ratings | **Important:** Do not use PowerFlex 40P or PowerFlex 520-Series drives on the same DC bus supply with PowerFlex 700/700S drives. This is due to the difference in capacitance/amps of the PowerFlex 40P or PowerFlex 520-Series drives compared to the PowerFlex 700/700S drives. |
| | PowerFlex 520-Series: All power ratings - Three phase only | |
| AC Drive 2 | PowerFlex 700/700S: Frames 0…4 | None |
| | PowerFlex 750-Series: Frames 1…4 | None |
| | Kinetix 7000: BM06…BM08 | None |
| | PowerFlex 40P: All power ratings | **Important:** Do not use PowerFlex 40P or PowerFlex 520-Series drives on the same DC bus supply with PowerFlex 750-Series drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P or PowerFlex 520-Series drives compared to the PowerFlex 750-Series drives and Kinetix 7000 drives. |
| | PowerFlex 520-Series: All power ratings - Three phase only | |

**Figure 32 - SCR Bus Supply with Stand-alone AC Drives with Internal Brake IGBT, and Kinetix 6000 Drive System**




❶ The common mode core mounting location (SCR Bus Supply DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with SCR bus supplies, the common mode core is placed at **either** the DC input terminals of each drive **or** at the motor output of each drive. Also, see Common Mode Core on page 136 for recommendations.
❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.
❸ A capacitor bank may be required. See Bus Supply Capacitors on page 134 for more information.
❹ See publication PFLEX-AT001 for minimum ohms.
❺ The braking IGBT should be connected to the largest frame size drive.

For all ground systems (solid, high resistance ground, and ungrounded), the same guidelines as previously described on page 41, page 42, and page 43 apply. In addition, adhere to the following braking IGBT conditions:

- See publication PFLEX-AT001 for minimum ohms.
- The braking IGBT should be connected to the largest frame size drive.

## General Considerations

**ATTENTION:** The incorrect use or configuration of third party assemblies can result in reduced system reliability and drive damage.

1. All system components (Bus Supply, PowerFlex and Kinetix Drives, and Braking Unit) must be selected for the same AC-line voltage.
2. A low inductance type DC bus must be used.
3. The braking chopper must be located next to the bus supply and the highest power drive.
4. A low inductance type DC bus must be used. See DC Bus Connections on page 15 for details.
5. The maximum wire length between the brake chopper and the highest power drive and between parallel brake choppers must be observed. See the respective braking product documentation for details.
6. If a disconnect switch between the common DC bus and the drive's input is used, an auxiliary contact on the disconnect switch must be connected to a digital input of the drive. The corresponding digital input must be set to 'PreCharge En'. This provides the proper precharge interlocking, guarding against possible damage to the drive when reconnecting the drive to an energized DC bus. Under this condition, the drives must have internal or externally-supplied precharge.

| Drive | Parameter | | Digital Input |
|---|---|---|---|
| | Number | Setting | |
| PowerFlex 40P | A051…A054 | 29 (PreCharge En) | 1…4 |
| PowerFlex 523 | t062…t066 | 30 (PreCharge En) | 2…6 |
| PowerFlex 525 | t062…t068 | 30 (PreCharge En) | 2…8 |
| PowerFlex 700 | 361…366 | 30 (PreCharge En) | 1…6 |
| PowerFlex 700L with vector control | | | |
| PowerFlex 700S | 825…830 | 30 (PreCharge En) | 1…6 |
| PowerFlex 700L with 700S control | | | |
| PowerFlex 700H | 361…366 | 30 (PreCharge En) | 1…6 |
| PowerFlex 750-Series | 189 [DI Precharge] | See Drive Programming Manual for programming information. | |

**ATTENTION:** The Kinetix family of drives have no external means of controlling the precharge; therefore, a DC disconnect must not be used.

7. If a drive from column A in the table below is mixed with a drive from column B, a capacitor bank is required. See Bus Supply Capacitors on page 134 for details.

| Column A Drives | Column B Drives |
|---|---|
| PowerFlex 700/700S: Frames 0…5<br>PowerFlex 750-Series: Frames 1…10<br>Kinetix 6000 and Kinetix 6200/6500<br>Kinetix 7000 | PowerFlex 700/700S: Frame 6<br>PowerFlex 700: Frames 8…10<br>PowerFlex 700H/700S: Frame 9 and up<br>PowerFlex 700L: All Frames |

8. PowerFlex 700 drives and PowerFlex 700 Series B drives must have firmware revision 2.001 or later (Standard and Vector Control).
9. For further assistance with this Common Bus configuration, contact Rockwell Automation SupportPlus engineering team at: http://www.ab.com/support/abdrives/files/supportplus.pdf

## PowerFlex Diode Bus Supply Considerations

The Diode Bus Supply can be used only with PowerFlex 700/700S Frame 0...4 drives, PowerFlex 750-Series Frame 1...4 drives, Kinetix 7000 BM06...BM08 drives, PowerFlex 40P drives (all power ratings), or PowerFlex 520-Series drives (all power ratings). This is because the Diode Bus Supply does not include precharge. The precharge function must be provided by the drives.

**ATTENTION:** Never connect Kinetix 7000 BM09…BM12 drives, Kinetix 6000-Series drives, or Kinetix 6200/6500 drives to a PowerFlex Diode Bus Supply in common bus configuration because there is no controlled, current-limited precharge of the DC bus capacitors, resulting in drive damage.

When using a PowerFlex Diode Bus Supply with the Brake Chopper, follow this additional recommendation:

An RC snubber circuit is required to prevent the DC bus voltage from exceeding the 1200V maximum Brake Chopper IGBT voltage. The RC snubber circuit must always be connected to the DC bus (located close to the braking chopper) to absorb the power-on voltage overshoot. See RC Snubber Circuit on page 136 for details.

## PowerFlex SCR Bus Supply Considerations

**ATTENTION:** The SCR Bus Supply includes precharge. The use of drives with precharge is not required **if and only if** power is removed and reconnected to the entire system, **and if** individual drives do not require to be isolated and reconnected to an energized bus through a disconnect switch. Failure to follow this recommendation results in drive damage.

1. To commission and test the SCR Bus Supply, a minimum capacitance is required. See Bus Supply Capacitors on page 134 for details.
2. AC line reactors for di/dt limitation and current sharing must be externally mounted for each PowerFlex SCR Bus Supply. See the PowerFlex SCR Bus Supply User Manual for line reactor information.

When using a PowerFlex SCR Bus Supply with a Braking Unit, follow this additional recommendation:

If the instantaneous Brake Chopper current is larger than 150% of the DC input rating of the largest drive, a capacitor bank is required and must be located as close as possible to the brake chopper and the rectifier source.

- **Exception 1:** The capacitor is not required if at least one drive without internal precharge (PowerFlex 700 Frames 5 and up, only DC input, Catalog Codes H and J) is always connected to the common DC bus.
- **Exception 2:** If a PowerFlex 700H/700S Frame 9 and up drive is interconnected with PowerFlex 700/700S Frame 0...6 drives, or PowerFlex 750-Series Frame 1...10 drives, and a capacitor bank with appropriate capacitance is already used. See the subsection Connecting High Power Drives and Low Power Drives on the DC Bus on page 134 for details.

## Sizing

### Drive Internal Brake IGBT

See the PowerFlex Dynamic Braking Resistor Calculator, publication PFLEX-AT001, for minimum resistance values.

### Bus Supplies

To avoid overloading the Bus Supply, the following requirements apply:

- The DC Input current sum (Normal Duty, Heavy Duty rating, or Light Duty at 40 °C/104 °F) of the connected drives must not exceed the continuous DC Bus output current rating of the Bus Supply.
- For the DC Input Current values of the drives, see the tables in Appendix A. In addition, the guidelines provided in the PowerFlex 700 User Manual, PowerFlex 700S/700H Installation Manual, or PowerFlex 750-Series Drive Technical Data also apply.

### *PowerFlex Diode Bus Supply*

The following examples show maximum loading of the Diode Bus Supply.

a) Normal Duty ND

| DC Input Rating of Connected Drives | | | | Diode Bus Supply | |
|---|---|---|---|---|---|
| DC Voltage | ND Power | ND Currents | ND Current Sum | Rated Cont. DC Output Amps | AC Input Voltage |
| 540V | 30 + 22 = 52 kW | 61.9 + 47.5 A | 109.4 A | 120 A | 400V |
| 650V | 2 x 40 = 80 HP | 2 x 55.7 A | 111.4 A | 120 A | 480V |

b) Heavy Duty HD

| DC Input Rating of Connected Drives | | | | Diode Bus Supply | |
|---|---|---|---|---|---|
| DC Voltage | HD Power | HD Currents | HD Current Sum | Rated Cont. DC Output Amps | AC Input Voltage |
| 540V | 2 x 15 = 30 kW | 2 x 40.9 A | 81.8 A | 120 A | 400V |
| 650V | 2 x 25 = 50 HP | 2 x 42.9 A | 85.8 A | 120 A | 480V |

Total the DC Input currents for all drives connected to the DC bus. This total must be less than 120A.

### *PowerFlex SCR Bus Supply*

The following examples show maximum loading of the SCR Bus Supply.

a) Normal Duty ND, 110%, 1 minute; 150%, 3 seconds

| DC Input Rating of Connected Drives | | | | SCR Bus Supply (1) | |
|---|---|---|---|---|---|
| DC Voltage | ND Power | ND Currents | ND Current Sum | Maximum DC Output Amps | AC Input Voltage |
| 540V | 3 x 110 kW<br>1 x 45 kW | 3 x 226 = 678 A<br>1 x 95 = 95 A | 773 A | 1000 A | 400V |
| 650V | 3 x 60 HP<br>1 x 30 HP | 3 x 84.5 = 253.5 A<br>1 x 42.9 = 42.9 A | 297 A | 400 A | 480V |

(1) No overload capability.

b) Heavy Duty HD, 150%, 1 minute; 200%, 3 seconds

| DC Input Rating of Connected Drives | | | | SCR Bus Supply (1) | |
|---|---|---|---|---|---|
| DC Voltage | HD Power | HD Currents | HD Current Sum | Maximum DC Output Amps | AC Input Voltage |
| 540V | 3 x 90 kW | 3 x 192.3 A = 577 A | 577 A | 600 A | 400V |
| 650V | 3 x 125 HP | 3 x 171 A = 513 A | 513 A | 600 A | 480V |

(1) No overload capability.

# Fusing

## DC Input Drives

See Appendix A for the recommended Common DC Bus drive fusing.

## PowerFlex Diode Bus Supply

See the PowerFlex Diode Bus Supply User Manual for recommended AC input fusing.

## PowerFlex SCR Bus Supply

The PowerFlex SCR Bus Supply has built-in AC line and DC bus fuses (on 400A and 600A units). The 1000A unit has six in-path fuses which simultaneously protect AC and DC paths. All units are equipped with fuse trip indicator switches. See the PowerFlex SCR Bus Supply User Manual for fusing information.

# Shared AC/DC Bus Configuration

## System Characteristics

**IMPORTANT** Although there are guidelines to help with AC input current sharing between drives for this configuration, current sharing cannot be assured. Therefore, the configurations shown in Chapter 2 or Chapter 6 are preferred.

This system is characterized by the use of stand-alone drives fed by a common 3-phase voltage source and the DC bus of each drive connected together.

## Supported Products

At the time of publication, the following drives can be used on a shared AC/DC bus configuration.

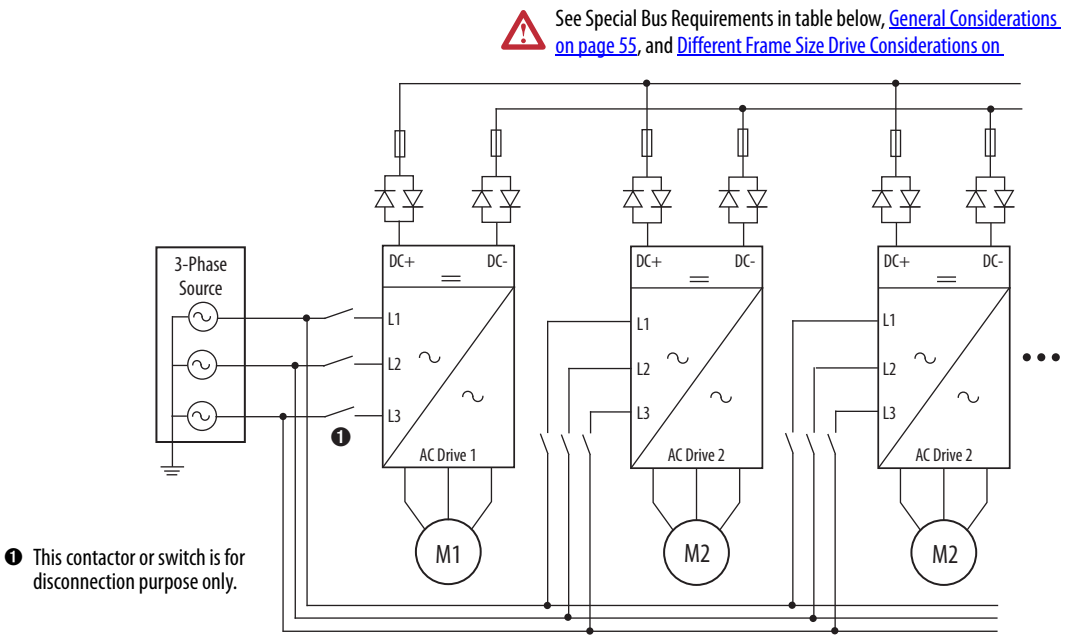
| Supported Drives |
|---|
| PowerFlex 40P: All power ratings |
| PowerFlex 520-Series: All power ratings - Three phase only |
| PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…6 (2) |
| PowerFlex 700S: Frames 1…6 (2) (3) |
| PowerFlex 750-Series: Frames 1…10 (4) |
| Kinetix 7000: BM06…BM12 |

(1) These drives require firmware revision 2.001 or later (Standard and Vector Control).
(2) PowerFlex 700 Frame 5 and 6, and PowerFlex 700S Frame 5 and 6 DC input drives are required when not connected to the AC source.
(3) There is no Frame 0 for PowerFlex 700S drives.
(4) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6, 7, and 8 drives.

# Typical System Configurations

## AC Drives of Different Frame Sizes from the Same Product Line

**Figure 33 - Different Frame Size Stand-alone AC Drives from the Same Product Line in a Shared AC/DC Bus Configuration**

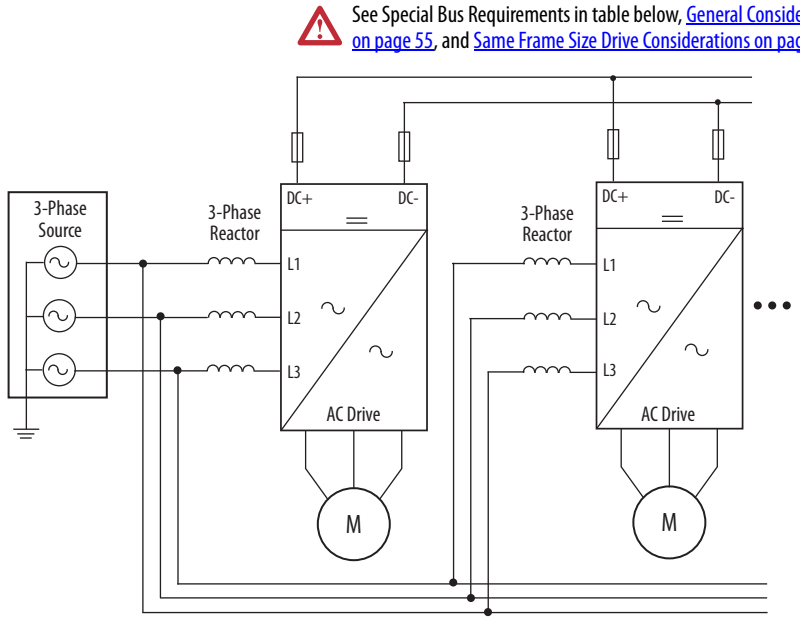



| Drawing Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive 1 | PowerFlex 700/700S: Frames 5 and 6<br>Kinetix 7000: BM09…BM12 | • Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 133 for more information.<br>• At 600 volts, PowerFlex 700/700S Frame 0…4 drives cannot be used on the same bus as PowerFlex 700/700S Frame 5 and 6 drives. |
| | PowerFlex 750-Series: Frames 5…10 | • Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 133 for more information.<br>• A DC input terminal kit must be ordered for Frames 6 and 7. |
| | PowerFlex 750-Series: Frames 6…10 | • At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives. |
| AC Drive 2 | PowerFlex 700/700S: Frames 0…4<br>PowerFlex 750-Series: Frames 1…4<br>Kinetix 7000: BM06…BM08 | • An individual or common contactor is required if AC bus is shared with PowerFlex 700/700S Frame 5 and 6 drives, or Kinetix 7000 BM09…BM12 drives.<br>• At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.<br>• Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 133 for more information. |

## Same Frame Size AC Drives from Same Product Line

*Using AC Input Reactors*

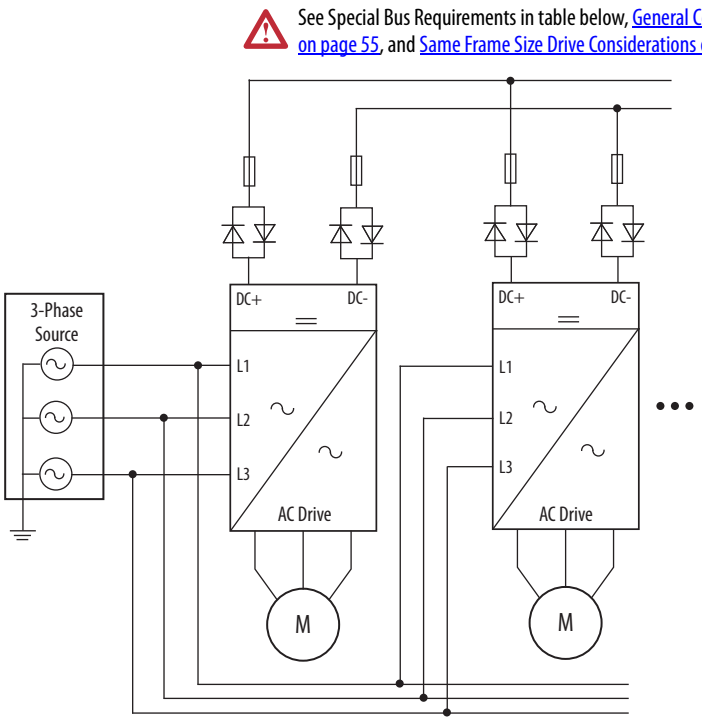
**Figure 34 - Same Frame Size Stand-alone AC Drives from Same Product Line in a Shared AC/DC Bus Configuration with AC Input Reactors for Proportional Current Sharing**




| Drawing Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive | PowerFlex 700/700S: Frames 0…6 | 3-Phase line reactors are required for proportional current sharing. See Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication DRIVES-UM001, for additional information. |
| | Kinetix 7000: BM06…BM12 | |
| | PowerFlex 750-Series: Frames 1…10 | • 3-Phase line reactors are required for proportional current sharing. See Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication DRIVES-UM001, for additional information.<br>• A DC input terminal kit must be ordered for Frames 6, 7, and 8. |

*Using Back-to-Back Diodes*

**Figure 35 - Same Frame Size Stand-alone AC Drives from Same Product Line in a Shared AC/DC Bus Configuration with Back-to-Back Diodes for Proportional Current Sharing**

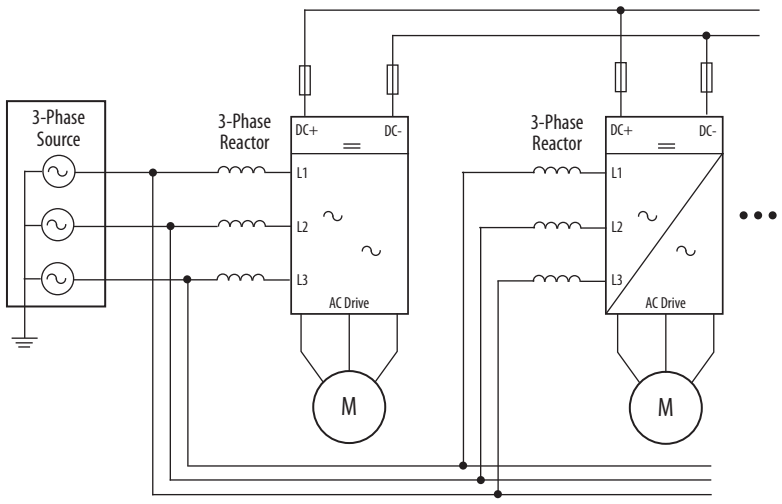



| Drawing Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive | PowerFlex 700/700S: Frames 0…6 | Back-to-back diodes are required for proportional current sharing. |
| | Kinetix 7000: BM06…BM12 | |
| | PowerFlex 750-Series: Frames 1…7 (1) | • Back-to-back diodes are required for proportional current sharing.<br>• A DC input terminal kit must be ordered for Frames 6, 7, and 8. |

(1) Back-to-back diodes are not supported on PowerFlex 750-Series Frame 8…10 drives.

## PowerFlex 40P or PowerFlex 520-Series Drives

**Figure 36 - PowerFlex 40P or PowerFlex 520-Series Drives in a Shared AC/DC Bus Configuration with AC Input Reactors for Proportional Current Sharing**




| Drawing Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive | PowerFlex 40P: All power ratings | See PowerFlex 40P or PowerFlex 520-Series Drive Considerations on page 57. |
| | PowerFlex 520-Series: All power ratings - Three phase only | |

## General Considerations

**ATTENTION:** The incorrect use or configuration of third party assemblies can result in reduced system reliability and drive damage.

1. Minimizing bus inductance is imperative. Drives must be mounted physically as close to each other as possible with all power wiring 'tied' together to minimize loop area.
2. If AC power is removed from one drive in a shared AC/DC bus, that drive can still be energized through the DC bus of another drive. Therefore, AC power to all of the drives in a shared AC/DC bus must be provided through a common disconnect switch or circuit breaker.
3. PowerFlex 700 drives and PowerFlex 700 Series B drives must have firmware revision 2.001 or later (Standard and Vector Control).

## Different Frame Size Drive Considerations

When the Shared AC/DC Bus line-up is composed of different frame size drives, two system phases must be taken into account. These are the precharge and loading phases of the drives within this configuration.

### Precharge

Due to the difference in the precharge circuitry between PowerFlex 700/700S Frame 0...4 drives and PowerFlex 750-Series Frame 1...7 drives when compared to PowerFlex 700/700S Frame 5 and 6 drives or PowerFlex 750-Series Frame 8...10 drives, the following considerations must be followed:

- An individual or a common contactor on the AC-side must be used for PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 1...7 drives. If PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 1...7 drives are not kept isolated from the AC power during precharge, the following drives precharge through the diode front end of the PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 1...7 drives:
  - PowerFlex 700/700S Frame 5 and 6 drives
  - PowerFlex 700VC Frame 7...10 drives
  - PowerFlex 700H/S Frame 9...14 drives
  - PowerFlex 750-Series Frame 8...10 drives

  This can result in diode front end or precharge resistor damage. See Figure 33 on page 52.

- Kinetix 7000 BM06...BM08 drives have the same precharge as PowerFlex 700/700S Frame 0...4 drives. Similarly, Kinetix 7000 BM09...BM12 drives have the same precharge as PowerFlex 700 Frame 5 drives. The same rules as described in the preceding bulleted text apply.

### Loading

When the larger power frame drive—or the sum of the power for the larger frame drives relative to the smallest power frame drives in the lineup—is loaded, the current through the small frame drive can exceed its current rating. To prevent this condition, these considerations must be followed.

1. **Diodes** - Back-to-back (dual pack) diodes with fuses must be used in the DC link of each drive to enable proportional sharing of input current by the converter section of each drive. **Failure to do so can result in drive damage**. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 133 for recommended part numbers.

2. The wiring and interconnection distances to the Common AC Bus must be minimized to prevent large variations of the input impedances between the drive inverters.

## Same Frame Size Drive Considerations

1. Individual line reactors for each drive or back-to-back diodes must be used for proportional current sharing. For line reactor information, see Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication DRIVES-UM001. For recommended diodes, see Back-to-Back Diodes (Shared AC/DC Configurations) on page 133.
2. The wiring and interconnection distances to the Common AC Bus must be minimized to prevent large variations of the input impedances between the drive inverters.

## PowerFlex 40P or PowerFlex 520-Series Drive Considerations

When using PowerFlex 40P or PowerFlex 520-Series drives in a shared bus configuration, the loading must be taken into account.

When the larger power frame drive—or the sum of the power for the larger frame drives relative to the smallest power frame drives in the lineup—is loaded, the current through the small frame drive can exceed its current rating. To prevent this condition, these guidelines must be followed.

1. Individual line reactors for each drive must be used for proportional current sharing. For line reactor information, see Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication DRIVES-UM001.
2. The wiring and interconnection distances to the Common AC Bus must be minimized to prevent large variations of the input impedances between the drive inverters.
3. Only multiple same size and type of drives on a shared AC/DC bus are recommended in the system configuration shown in Figure 36 on page 55. PowerFlex 40P or PowerFlex 520-Series drives **must not be combined** with PowerFlex 700/700S/750-Series drives on the same shared AC/DC bus.

## Sizing

Each drive must be sized for the motor load connected to it.

## Fusing

Drives **must not be** 'daisy chained'. Configure the shared DC bus in a 'star' configuration to enable proper fusing. Fast semiconductor fuses must be used in the DC links to minimize destructive energy in the event of a part or control malfunction. The fuses must be sized to handle large peak currents at the end of precharge.

See Appendix A for the recommended Common DC Bus drive fusing.

# Shared AC/DC Bus Configuration—with Braking DC Bus Regulation

## System Characteristics

**IMPORTANT** Although there are guidelines to help with AC input current sharing between drives for this configuration, current sharing cannot be assured. Therefore, the configurations shown in Chapter 3 or Chapter 7 are preferred.

This system is characterized by the use of stand-alone drives fed by a common 3-phase voltage source and the DC bus of each drive connected together. In addition, a Braking Chopper, Dynamic Braking Unit, or the drive's internal IGBT with a braking resistor for power dissipation of regenerative energy is also used. Rockwell Automation does not offer external braking products. Please contact our Encompass Partners for these braking products.

## Supported Products

At the time of publication, the following products are supported.

| Products | Supported Drives |
|---|---|
| Brake Chopper Module | PowerFlex 40P: All power ratings |
| | PowerFlex 520-Series: All power ratings - Three phase only |
| | PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…6 (2) |
| | PowerFlex 700S: Frames 1…6 (2) (3) |
| | PowerFlex 750-Series: Frames 1…10 (4) |
| | Kinetix 7000: BM06…BM12 |
| Heavy Duty Dynamic Brake Unit | PowerFlex 40P: All power ratings |
| | PowerFlex 520-Series: All power ratings - Three phase only |
| | PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…6 (2) |
| | PowerFlex 700S: Frames 1…6 (2) (3) |
| | PowerFlex 750-Series: Frames 1…10 (4) |
| | Kinetix 7000: BM06…BM12 |

(1) These drives require firmware revision 2.001 or later (Standard and Vector Control).
(2) PowerFlex 700 Frame 5 and 6 and PowerFlex 700S Frame 5 and 6 DC input drives are required when not connected to the AC source.
(3) There is no Frame 0 for PowerFlex 700S drives.
(4) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

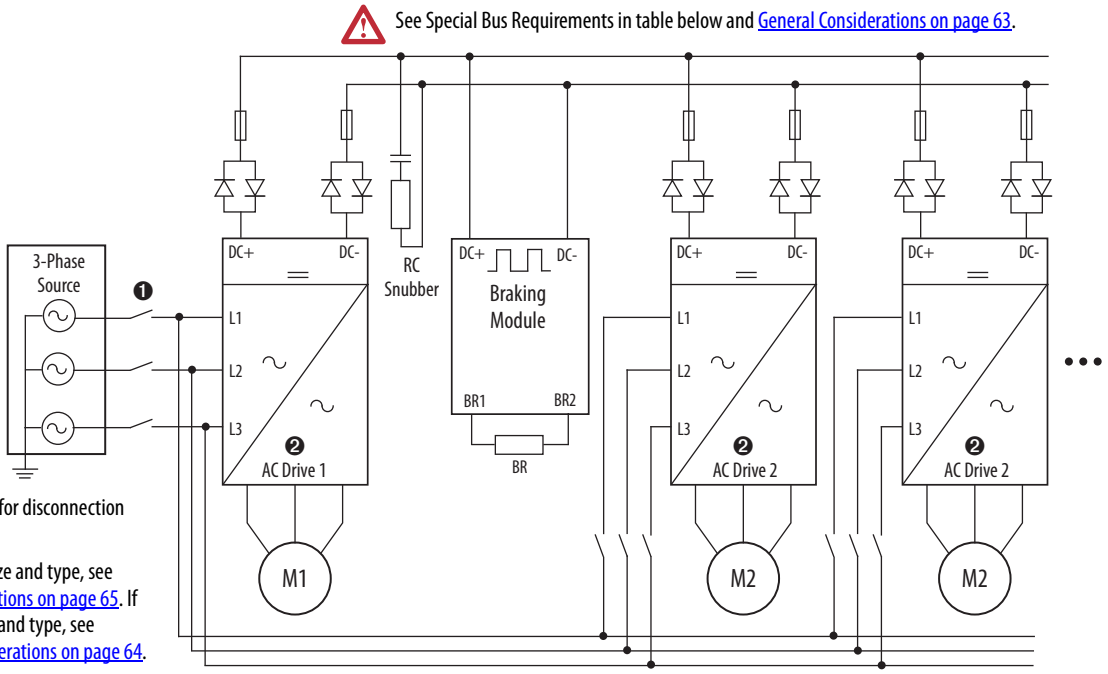
Note – When applicable and within the power limitation, the drive's internal IGBT can also be used.

| Drive | Internal Brake IGBT |
|---|---|
| PowerFlex 40P | Standard on all power ratings |
| PowerFlex 520-Series | Standard on all power ratings |
| PowerFlex 700 | Standard on Frames 0…3; optional on Frames 4…6 |
| PowerFlex 700S | Standard on Frames 1…3; optional on Frames 4…6, and 9 |
| PowerFlex 750-Series | Standard on Frames 1…5; optional on Frames 6 and 7 |
| Kinetix 7000 | No internal brake IGBT |
| Kinetix 6000 and Kinetix 6200/6500 | Internal bus regulation cannot be used. |

**ATTENTION:** The internal IGBT in a Kinetix 6000 Multi-Axis Servo Drive is disabled in 'Common Bus Follower' mode.

# Typical System Configurations

**Figure 37 - Stand-alone AC Drives with a Braking Module in a Shared AC/DC Bus Configuration**

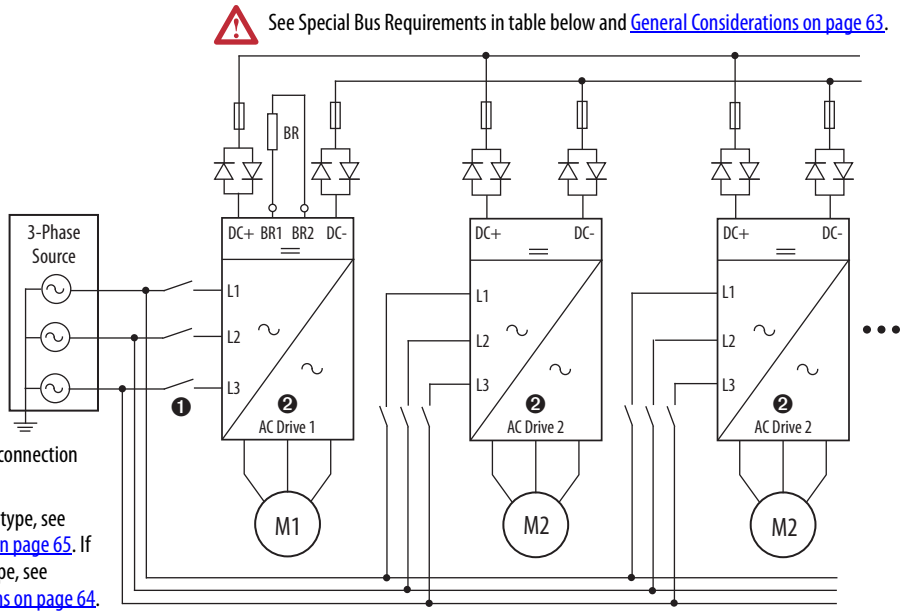



❶ This contactor or switch is for disconnection purpose only.

❷ If drives are of the same size and type, see Same Size Drive Considerations on page 65. If drives are of different size and type, see Different Size Drive Considerations on page 64.

| Drawing Designation | Supported Drives/Products | Special Bus Requirements |
|---|---|---|
| AC Drive 1 | PowerFlex 700/700S: Frames 5 and 6<br>Kinetix 7000: BM09…BM12 | • Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 133 for more information.<br>• At 600 volts, PowerFlex 700/700S Frame 0…4 drives cannot be used on the same bus as PowerFlex 700/700S Frame 5 and 6 drives. |
| | PowerFlex 750-Series: Frames 5…10 | • Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 133 for more information.<br>• A DC input terminal kit must be ordered for Frames 6, 7, and 8. |
| | PowerFlex 750-Series: Frames 6…10 | • At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives. |
| AC Drive 2 | PowerFlex 700/700S: Frames 0…4<br>PowerFlex 750-Series: Frames 1…4<br>Kinetix 7000: BM06…BM08 | • An individual or common contactor is required if the AC bus is shared with PowerFlex 700/700S Frame 5 and 6 drives or Kinetix 7000 BM09…BM12 drives.<br>• At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.<br>• Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 133 for more information. |
| Braking Module | Encompass Partner product | An RC Snubber is required to limit DC bus voltage overshoot at power-on. See RC Snubber Circuit on page 136 for more information. |

**Figure 38 - Stand-alone AC Drives with an Internal Brake IGBT in a Shared AC/DC Bus Configuration**



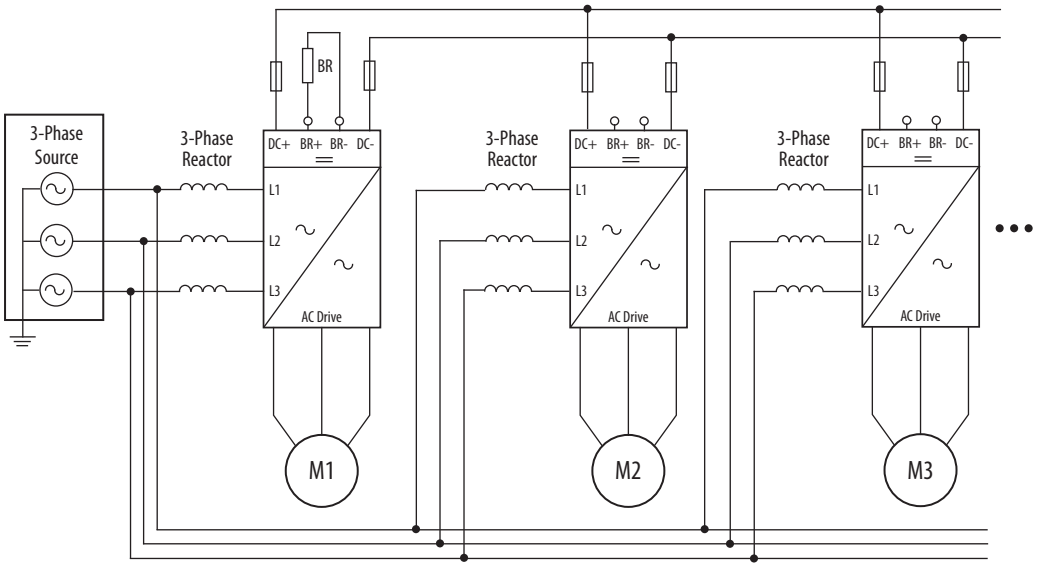

❶ This contactor or switch is for disconnection purpose only.

❷ If drives are of the same size and type, see Same Size Drive Considerations on page 65. If drives are of different size and type, see Different Size Drive Considerations on page 64.

| Drawing Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive 1 | PowerFlex 700/700S: Frames 5 and 6<br>Kinetix 7000: BM09…BM12 | • Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 133 for more information.<br>• At 600 volts, PowerFlex 700/700S Frame 0…4 drives cannot be used on the same bus as PowerFlex 700/700S Frame 5 and 6 drives.<br>• A Kinetix 7000 BM09…BM12 drive does not have an internal brake IGBT so it cannot be used to internally regulate the DC bus. |
| | PowerFlex 750-Series: Frames 5…10 | • Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 133 for more information.<br>• A DC input terminal kit must be ordered for Frames 6, 7, and 8. |
| | PowerFlex 750-Series: Frames 6…10 | • At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives. |
| AC Drive 2 | PowerFlex 700/700S: Frames 0…4<br>PowerFlex 750-Series: Frames 1…4<br>Kinetix 7000: BM06…BM08 | • Back-to-back diodes are required for proportional current sharing in a shared AC/DC configuration with different size drives. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 133 for more information.<br>• An individual or common contactor is required if AC bus is shared with PowerFlex 700/700S Frame 5 or 6 drives.<br>• At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.<br>• A Kinetix 7000 BM06…BM08 drive does not have an internal brake IGBT so it cannot be used to internally regulate the DC bus. |

**Figure 39 - Stand-alone PowerFlex 40P Drives (all Power Ratings) with Internal Brake IGBT in a Shared AC/DC Bus Configuration**

See PowerFlex 40P or PowerFlex 520-Series Drive Considerations on page 65.




| Drawing Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive | PowerFlex 40P: All power ratings | See PowerFlex 40P or PowerFlex 520-Series Drive Considerations on page 65. |
| | PowerFlex 520-Series: All power ratings - Three phase only | |

## General Considerations

**ATTENTION:** The incorrect use or configuration of third party assemblies can result in reduced system reliability and drive damage.

1. Connection of the braking resistor must be on the highest power drive. If all are the same rating, then closest to the drive that regenerates the most. Minimizing DC bus inductance is imperative. Drives must be mounted physically as close to each other as possible with all power wiring 'tied' together to minimize loop area. If minimizing the physical distance between the units is not possible, a capacitor bank is required which must be located closest to the drive with the braking resistor.
2. An RC Snubber circuit must be used in a shared AC/DC Bus Configuration when a PowerFlex 700/700S Frame 0...4 drive, PowerFlex 750-Series Frame 1...10 drive, Kinetix 7000 BM06...BM08 drive, PowerFlex 40 drive, or PowerFlex 520-Series drive is used with a Brake Chopper. See RC Snubber Circuit on page 136 for more information.
3. If AC power is removed from one drive in a shared AC/DC bus, that drive can still be energized through the DC bus of another drive. Therefore, AC power to all of the drives in a shared AC/DC bus must be provided through a common disconnect switch or circuit breaker.

4. PowerFlex 700 drives and PowerFlex 700 Series B drives must have firmware revision 2.001 or later (Standard and Vector Control).

## Different Size Drive Considerations

When the Shared AC/DC Bus line-up is composed of different frame size drives, two system phases must be taken into account. These are the precharge and loading phases of the drives within this configuration.

### Precharge

Due to the difference in the precharge circuitry between PowerFlex 700/700S Frame 0...4 drives and PowerFlex 750-Series Frame 1...7 drives when compared to PowerFlex 700/700S Frame 5 and 6 drives or PowerFlex 750-Series Frame 8...10 drives, the following considerations must be followed:

- An individual or a common contactor on the AC-side must be used for PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 1...7 drives. If PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 1...7 drives are not kept isolated from the AC power during precharge, the following drives precharge through the diode front end of the PowerFlex 700/700S Frame 0...4 drives or PowerFlex 750-Series Frame 1...7 drives.
  - PowerFlex 700/700S Frame 5 and 6 drives
  - PowerFlex 700VC Frame 7...10 drives
  - PowerFlex 700H/S Frame 9...14 drives
  - PowerFlex 750-Series Frame 8...10 drives

  This can result in diode front end damage. See Figure 37 on page 61 and Figure 39 on page 63.

- Kinetix 7000 BM06...BM08 drives have the same precharge as PowerFlex 700/700S Frame 0...4 drives. Similarly, Kinetix 7000 BM09...BM12 drives have the same precharge as PowerFlex 700 Frame 5 drives. The same rules as described in the preceding bulleted text apply.

### Loading

When the larger power frame drive—or the sum of the power for the larger frame drives relative to the smallest power frame drives in the lineup—is loaded, the current through the small frame drive can exceed its current rating. To prevent this condition, comply with the following considerations.

1. **Diodes** - Back-to-back (dual pack) diodes with fuses must be used in the DC link of each drive to enable proportional sharing of input current by the converter section of each drive. **Failure to do so can result in drive damage**. See Back-to-Back Diodes (Shared AC/DC Configurations) on page 133 for recommended part numbers.
2. The wiring and interconnection distances to the AC input connections must be minimized to prevent large variations of the input impedances between the drives.
3. If a 3-phase line reactor is used, the Common AC must be drawn from the load side of the reactor (see Figure 37 on page 61).

## Same Size Drive Considerations

1. Individual line reactors for each drive or back-to-back diodes must be used for proportional current sharing. For line reactor information, see Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication DRIVES-UM001. For recommended diodes, see Back-to-Back Diodes (Shared AC/DC Configurations) on page 133.
2. The wiring and interconnection distances to the Common AC Bus must be minimized to prevent large variations of the input impedances between the drive inverters.

## PowerFlex 40P or PowerFlex 520-Series Drive Considerations

When using PowerFlex 40P or PowerFlex 520-Series drives in a shared bus configuration, the loading must be taken into account.

When the larger power frame drive—or the sum of the power for the larger frame drives relative to the smallest power frame drives in the lineup—is loaded, the current through the small frame drive can exceed its current rating. To prevent this condition, these guidelines must be followed.

1. Individual line reactors for each drive must be used for proportional current sharing. For line reactor information, see Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication DRIVES-UM001.
2. The wiring and interconnection distances to the Common AC Bus must be minimized to prevent large variations of the input impedances between the drive inverters.
3. Only multiple same size and type of drives on a shared AC/DC bus are recommended in the system configuration shown in Figure 39 on page 63. PowerFlex 40P or PowerFlex 520-Series drives **must not be combined** with PowerFlex 700/700S/750-Series drives on the same shared AC/DC bus.

## Sizing

Each drive must be sized for the motor load connected to it.

## Fusing

Drives **must not be** 'daisy chained'. Configure the shared DC bus in a 'star' configuration to enable proper fusing. Fast semiconductor fuses must be used in the DC links to minimize destructive energy in the event of a part or control malfunction. The fuses must be sized to handle large peak currents at the end of precharge.

See Appendix A for the recommended Common Bus DC drive fusing.

# Shared DC Bus Configuration (Piggy Back)

## System Characteristics

This system is characterized by the use of one stand-alone drive as the converter and additional common DC bus drives used in a shared DC bus configuration.

## Supported Products

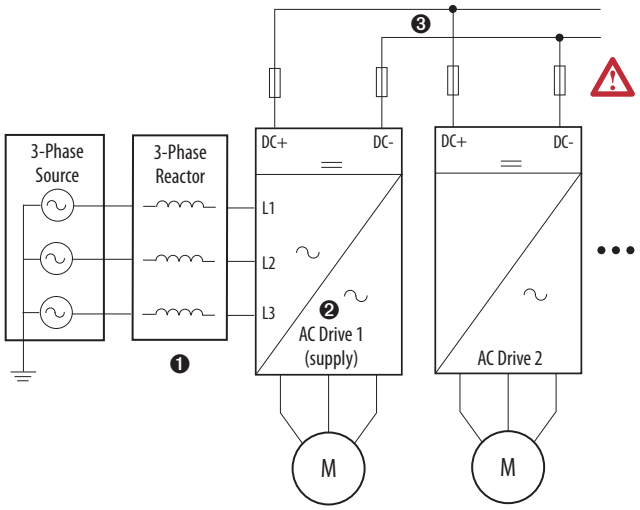
At the time of publication, the following drives are supported when used on a shared DC bus configuration.

| Supported Drives |
|---|
| PowerFlex 40P: All power ratings |
| PowerFlex 520-Series: All power ratings - Three phase only |
| PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…10 (2) |
| PowerFlex 700S: All frame sizes (2) |
| PowerFlex 700H: All frame sizes (2) |
| PowerFlex 700L: All frame sizes (2) |
| PowerFlex 750-Series: Frames 1…10 (3) |
| Kinetix 7000: BM06…BM12 |
| Kinetix 6000 and Kinetix 6200/6500: B-Series Configurations |

(1) These drives require firmware revision 2.001 or later (Standard and Vector Control).
(2) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.
(3) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

# Typical System Configurations

**Figure 40 - Stand-alone AC Drives in a Shared DC Bus Configuration**




See Special Bus Requirements footnotes in table below and General Considerations on page 69.

❶ A 3-Phase line reactor is only required for special line considerations. See Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication DRIVES-UM001, for additional information.

❷ Supply drive must be sized to source current to all connected drives during all modes of operation that are encountered.

❸ At 600 volts, PowerFlex 700/700S Frame 0…4 drives cannot be used on the same bus as PowerFlex 700/700S Frame 5 and 6 drives. Also, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.

**Drive Compatibility Matrix**

| | | | AC Drive 1 (Supply) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PowerFlex | | | | | | | | | Kinetix | | |
| | | | 40P | 520-Series | 700/700S Frames 0…4 | 700/700S Frames 5…6 | 700 Frames 7…10 | 700H/700S Frames 9…14 | 700L Frames 2, 3A, and 3B | 750-Series Frames 1…4 | 750-Series Frames 5…10 | BM06…BM08 | BM09…BM12 | 6000 & 6200/ 6500 (460V) |
| AC Drive 2 | PowerFlex | 40P | Yes (1) | Yes (1) | | | | | | | | | | |
| | | 520-Series | Yes (1) | Yes (1) | | | | | | | | | | |
| | | 700/700S Frames 0…4 | | | Yes | Yes (2) | Yes | Yes (4) | Yes (4) | | | Yes | Yes | |
| | | 700/700S Frames 5…6 | | | | Yes (3) | Yes (3) | Yes (3) (4) | Yes (3) (4) | | | | Yes (3) | |
| | | 700 Frames 7…10 | | | | | Yes (3) | | | | | | | |
| | | 750-Series Frames 1…4 | | | | | | | | Yes (5) | Yes (5) (6) | | | |
| | | 750-Series Frames 5…10 | | | | | | | | | Yes (5) (6) | | | |
| | | 700H/700S Frames 9…14 | | | | | | Yes (3) (4) | | | | | | |
| | | 700L Frames 3A and 3B | | | | | | | Yes (3) (4) | | | | | |
| | Kinetix | BM06…BM08 | | | Yes | Yes | | Yes (4) | | | | Yes | Yes | |
| | | BM09…BM12 | | | | Yes | | Yes (4) | | | | | Yes | |
| | | 6000 and 6200/ 6500 (460V) | | | | Yes | | Yes (4) | | | | | Yes | |

**Special Bus Requirements**

(1) See PowerFlex 40P or PowerFlex 520-Series Drive Considerations on page 69.
(2) At 600 volts, PowerFlex 700/700S Frame 0…4 drives cannot be used on the same bus as PowerFlex 700/700S Frame 5 and 6 drives.
(3) DC input 'Common Bus' drives are required when not connected to an AC source.
(4) Total capacitance of externally connected drives must not exceed the maximum allowable external capacitance of the supply drive or the precharge resistors will overheat. The maximum allowable external capacitance for each drive is listed in related tables in Appendix A.
(5) At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.
(6) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6, 7, and 8 drives.

## General Considerations

**ATTENTION:** The incorrect use or configuration of third party assemblies can result in reduced system reliability and drive damage.

1. Minimizing bus inductance is imperative. Drives must be mounted physically as close to each other as possible with all power wiring 'tied' together to minimize loop area.
2. For further assistance with this Common Bus configuration, contact Rockwell Automation SupportPlus engineering team at: http://www.ab.com/support/abdrives/files/supportplus.pdf

## PowerFlex 40P or PowerFlex 520-Series Drive Considerations

PowerFlex 40P or PowerFlex 520-Series drives **must not be used** on the same DC bus supply as PowerFlex 700/700S/700H/700L/750-Series drives. This is due to the difference in capacitance/amps of the PowerFlex 40P or PowerFlex 520-Series drives compared to the PowerFlex 700/700S/700H/700L/750-Series drives.

## Sizing

The total motoring load must not exceed the rated load for the drive sourcing the DC power. Each DC-fed drive must be sized for the motor load connected to it.

## Fusing

Drives **must not be** 'daisy chained'. Configure the shared DC bus in a 'star' configuration to enable proper fusing. Fast semiconductor fuses must be used in the DC links to minimize destructive energy in the event of a part or control malfunction. The fuses must be sized to handle large peak currents at the end of precharge.

See Appendix A for the recommended Common DC Bus drive fusing.

## Notes:

# Shared DC Bus Configuration (Piggy Back)—with Braking Chopper

## System Characteristics

This system is characterized by the use of one stand-alone drive as the converter and additional common DC bus drives used in a shared DC bus configuration. In addition, a Braking Chopper, Dynamic Braking Unit, or the drive's internal IGBT with a braking resistor for power dissipation of regenerative energy is also used.

## Supported Products

At the time of publication, the following products are supported.

| Products | Supported Drives |
|---|---|
| Brake Chopper Module | PowerFlex 40P: All power ratings |
| | PowerFlex 520-Series: All power ratings - Three phase only |
| | PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…10 (2) |
| | PowerFlex 700S: All frame sizes (2) |
| | PowerFlex 700H: All frame sizes (2) |
| | PowerFlex 700L: All frame sizes (2) |
| | PowerFlex 750-Series: Frames 1…10 (3) |
| | Kinetix 7000: BM06…BM12 |
| | Kinetix 6000 and Kinetix 6200/6500 – All 460V configurations (4) |
| Heavy Duty Dynamic Brake Unit | PowerFlex 40P: All power ratings |
| | PowerFlex 520-Series: All power ratings - Three phase only |
| | PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…10 (2) |
| | PowerFlex 700S: All frame sizes (2) |
| | PowerFlex 700H: All frame sizes (2) |
| | PowerFlex 700L: All frame sizes (2) |
| | PowerFlex 750-Series: Frames 1…10 (3) |
| | Kinetix 7000: BM06…BM12 |
| | Kinetix 6000 and Kinetix 6200/6500: All 460V configurations (4) |

(1) These drives require firmware revision 2.001 or later (Standard and Vector Control).

(2) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.

(3) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

(4) Kinetix 6000 configurations require firmware revision 1.92 or later.

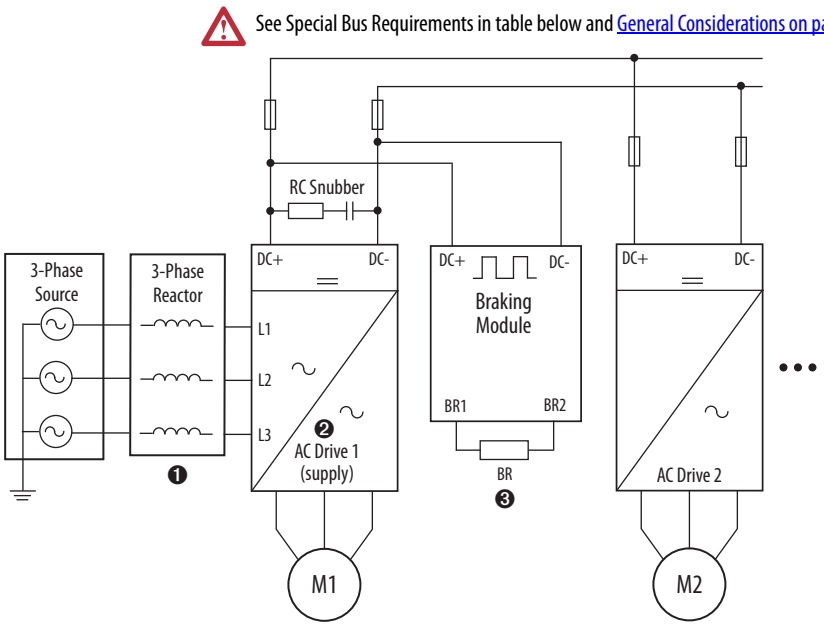
Note – When applicable, the drive's internal IGBT can also be used.

| Drive | Internal Brake IGBT |
|---|---|
| PowerFlex 40P | Standard on all power ratings |
| PowerFlex 520-Series | Standard on all power ratings |
| PowerFlex 700 | Standard on Frames 0…3; optional on Frames 4…6 |
| PowerFlex 700S | Standard on Frames 1…3; optional on Frames 4…6, and 9 |
| PowerFlex 700H | Optional in Frame 9 only |
| PowerFlex 750-Series | Standard on Frames 1…5; optional on Frames 6 and 7;<br>Frames 8…10 have no internal brake IGBT |
| Kinetix 7000 | No internal brake IGBT |
| Kinetix 6000 and Kinetix 6200/6500 | Internal bus regulation cannot be used |

**ATTENTION:** The internal IGBT in a Kinetix 6000 Multi-Axis Servo Drive is disabled in 'Common Bus Follower' mode.

# Typical System Configurations

**Figure 41 - AC Drives with a Braking Module in a Shared DC Bus Configuration**




❶ A 3-Phase line reactor is only required for special line considerations. See Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication DRIVES-UM001, for additional information.

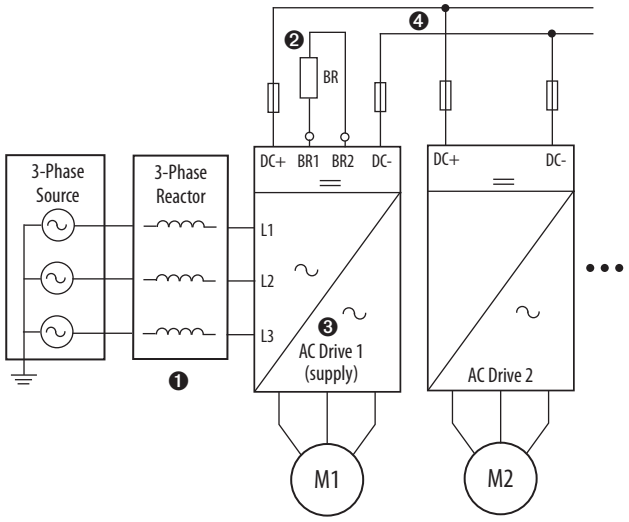
❷ Supply drive must be able to source current to all connected drives during all modes of operation that are encountered.

❸ The brake module must be connected closest to the supply drive. The brake and resistor must be sized no bigger than the capacity of the supply drive.

| Drawing Designation | Supported Drives/Product | Special Bus Requirements |
|---|---|---|
| AC Drive 1 (supply) | See the Drive Compatibility Matrix on page 74 for supported drives and special bus requirements. | |
| AC Drive 2 | | |
| Braking Module | Encompass Partner product | An RC Snubber is required when supply drive is a PowerFlex 700/700S Frame 0…4, PowerFlex 750-Series Frame 1…10 drive, or a Kinetix 7000 BM06…BM08 drive. See RC Snubber Circuit on page 136 for more information. |

**Figure 42 - AC Drives Using an Internal Braking IGBT in a Shared DC Bus Configuration**

See Special Bus Requirements footnotes in table below and General Considerations on page 75.




❶ A 3-Phase line reactor is only required for special line considerations. See Wiring and Grounding Guidelines for Pulse Width Modulated (PWM) AC Drives, publication DRIVES-UM001, for additional information.

❷ Only drives listed in the table on page 72 have internal brake IGBTs. See publication PFLEX-AT001 for minimum resistance.

❸ Supply drive must be able to source current to all connected drives during all modes of operation that are encountered.

❹ At 600 volts, PowerFlex 700/700S Frame 0…4 drives cannot be used on the same bus as PowerFlex 700/700S Frame 5 and 6 drives. Also, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.

**Drive Compatibility Matrix**

| | | | AC Drive 1 (Supply) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | PowerFlex | | | | | | | Kinetix | | |
| | | | 40P | 520-Series | 700/700S Frames 0…4 | 700/700S Frames 5…6 | 700H/700S Frame 9 | 750-Series Frames 1…4 | 750-Series Frames 5…10 | BM06…BM08 | BM09…BM12 | 6000 & 6200/ 6500 (460V) |
| AC Drive 2 | PowerFlex | 40P | Yes (1) | Yes (1) | | | | | | | | |
| | | 520-Series | Yes (1) | Yes (1) | | | | | | | | |
| | | 700/700S Frames 0…4 | | | Yes | Yes (2) | Yes (4) | | | Yes | Yes | |
| | | 700/700S Frames 5…6 | | | | Yes (3) | Yes (3) (4) | | | | Yes (3) | |
| | | 750-Series Frames 1…4 | | | | | | Yes (5) | Yes (5) (6) | | | |
| | | 750-Series Frames 5…10 | | | | | | | Yes (5) (6) | | | |
| | | 700H/700S Frame 9 | | | | | Yes (3) (4) | | | | | |
| | Kinetix | BM06…BM08 | | | Yes | Yes | Yes (4) | | | Yes | Yes | |
| | | BM09…BM12 | | | | Yes | Yes (4) | | | | Yes | |
| | | 6000 and 6200/ 6500 (460V) | | | | Yes | Yes (4) | | | | Yes | |

**Special Bus Requirements**

(1) See PowerFlex 40P or PowerFlex 520-Series Drive Considerations on page 75.
(2) At 600 volts, PowerFlex 700/700S Frame 0…4 drives cannot be used on the same bus as PowerFlex 700/700S Frame 5 and 6 drives.
(3) DC input 'Common Bus' drives are required when not connected to an AC source.
(4) Total capacitance of externally connected drives must not exceed the maximum allowable external capacitance of the supply drive or the precharge resistors will overheat. The maximum allowable external capacitance for each drive is listed in related tables in Appendix A.
(5) At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.
(6) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6, 7, and 8 drives.

## General Considerations

**ATTENTION:** The incorrect use or configuration of third party assemblies can result in reduced system reliability and drive damage.

1. The brake unit must be connected to the terminals of the drive used as the converter. The brake module and resistor must be sized no bigger than the capacity of the supply drive. This enables the drives to regenerate power to the large drive capacitor bank at current limit values if necessary. The large drive can then dump large amounts of peak power to a properly-sized brake unit without stressing the small drives.
2. Minimizing bus inductance is imperative. Drives must be mounted physically as close to each other as possible with all power wiring 'tied' together to minimize loop area.
3. An R-C Snubber circuit must be used in a Shared DC Bus configuration when the main drive is a PowerFlex 700/700S Frame 0...4, PowerFlex 750-Series Frame 1...10, PowerFlex 40P, or PowerFlex 520-Series drive, and a Brake Chopper is used. See RC Snubber Circuit on page 136 for more information.
4. For further assistance with this Common Bus configuration, contact Rockwell Automation SupportPlus engineering team at: http://www.ab.com/support/abdrives/files/supportplus.pdf

## PowerFlex 40P or PowerFlex 520-Series Drive Considerations

PowerFlex 40P or PowerFlex 520-Series drives **must not be used** on the same DC bus supply as PowerFlex 700/700S/700H/700L/750-Series drives. This is due to the difference in capacitance/amps of the PowerFlex 40P or PowerFlex 520-Series drives compared to the PowerFlex 700/700S/700H/700L/750-Series drives.

## Sizing

The total motoring load must not exceed the rated load for the drive sourcing the DC power. Each DC-fed drive must be sized for the motor load connected to it.

## Fusing

Drives **must not be** 'daisy chained'. Configure the shared DC bus in a 'star' configuration to enable proper fusing. Fast semiconductor fuses must be used in the DC links to minimize destructive energy in the event of a part or control malfunction. The fuses must be sized to handle large peak currents at the end of precharge.

See Appendix A for the recommended Common DC Bus drive fusing.

## Notes:

# Regenerative Bus Supply Configuration

## System Characteristics

This system is characterized by a PWM-controlled IGBT converter for full regeneration of power to the AC line. The regenerative bus supply puts energy back onto the distribution system instead of dissipating energy with resistor braking technology. This configuration provides low AC line harmonics and can be used to meet IEEE-519 when used with the appropriate filtering.

## Supported Products

At the time of publication, the following products are supported.

| Products | Supported Drives |
|---|---|
| PowerFlex Active Front End | PowerFlex 40P: All power ratings |
| | PowerFlex 520-Series: All power ratings - Three phase only |
| | PowerFlex 700 (1) / PowerFlex 700 Series B (1): All frame sizes (2) |
| | PowerFlex 700S: All frame sizes (2) |
| | PowerFlex 700H: All frame sizes (2) |
| | PowerFlex 750-Series: Frames 1…10 (3) |
| | Kinetix 7000: BM06…BM12 |
| | Kinetix 6000 and Kinetix 6200/6500: All 460V configurations |

(1) These drives require firmware revision 2.001 or later (Standard and Vector Control).

(2) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.

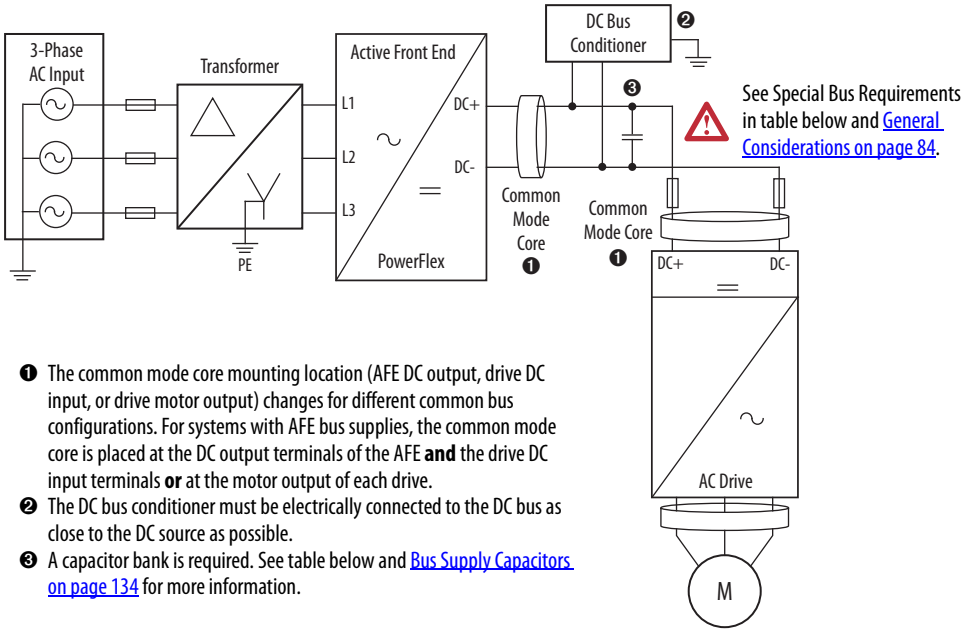
(3) PowerFlex 750-Series Frame 5…10 DC input version drives with precharge must be selected.

# Typical System Configurations

This section is categorized by type of grounding (solid ground, high resistance ground, or ungrounded), a single AFE providing power to a single drive, and a single AFE providing power to multiple drives.

## Solid Ground System with Single AFE and Single AC Drive

**Figure 43 - Solid Ground System with Single AFE and Single AC Drive**




❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core (3) | DC Bus Conditioner (7) |
|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty | Frame Size | Qty | Type | | |
| Solid | 400/480 | 1 | 10 (1) or 13 (2) | 1 | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design G |
| | 600 | | | | PowerFlex 750-Series: Frames 3 and 4 | | Design G |
| Solid | 400/480 | 1 | 10 (1) or 13 (2) | 1 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design G |
| | 600/690 | | | | | | Design G |
| Solid | 400/480 | 1 | 10 (1) or 13 (2) | 1 | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 (4) or 30201-031-01/1321-M670 (5) | Design E |
| | 600/690 | | | | | | Design E |
| Solid | 400/480 | 1 | 10 (1) or 13 (2) | 1 | Any other non-listed PowerFlex drive | Contact Factory (6) | |
| | 600/690 | | | | | | |

(1) For PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.

(2) For PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.

(3) One common mode core is required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.

(4) Drive DC input common mode core.

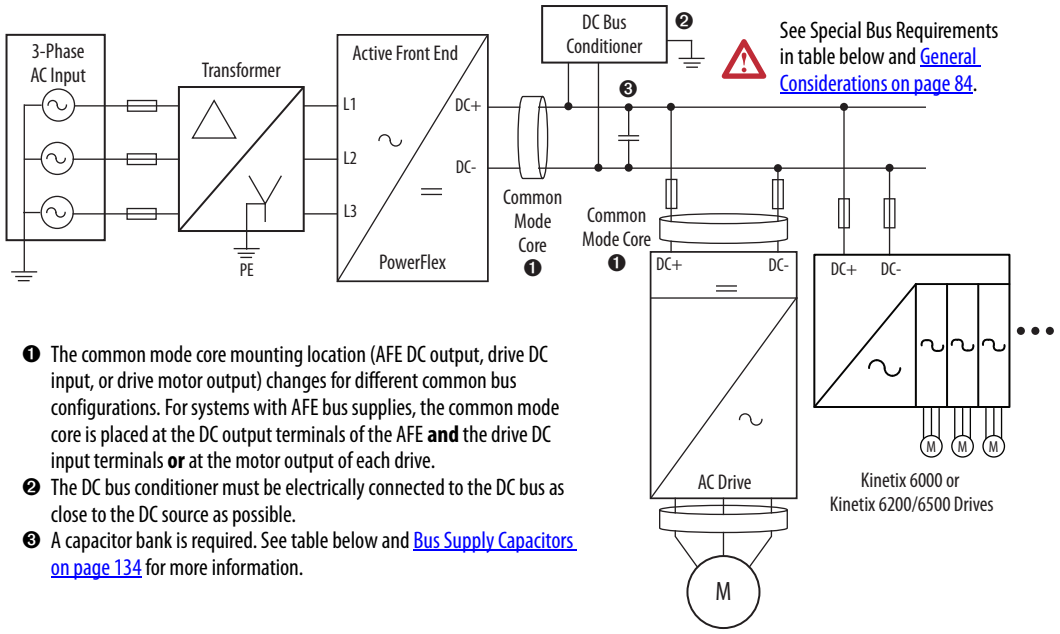
(5) Drive motor output common mode core.

(6) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.

(7) One DC bus conditioner is required for each PowerFlex AFE. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.

## Solid Ground System with Single AFE and Multiple AC Drives

**Figure 44 - Solid Ground System with Single AFE and Multiple AC Drives**




❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

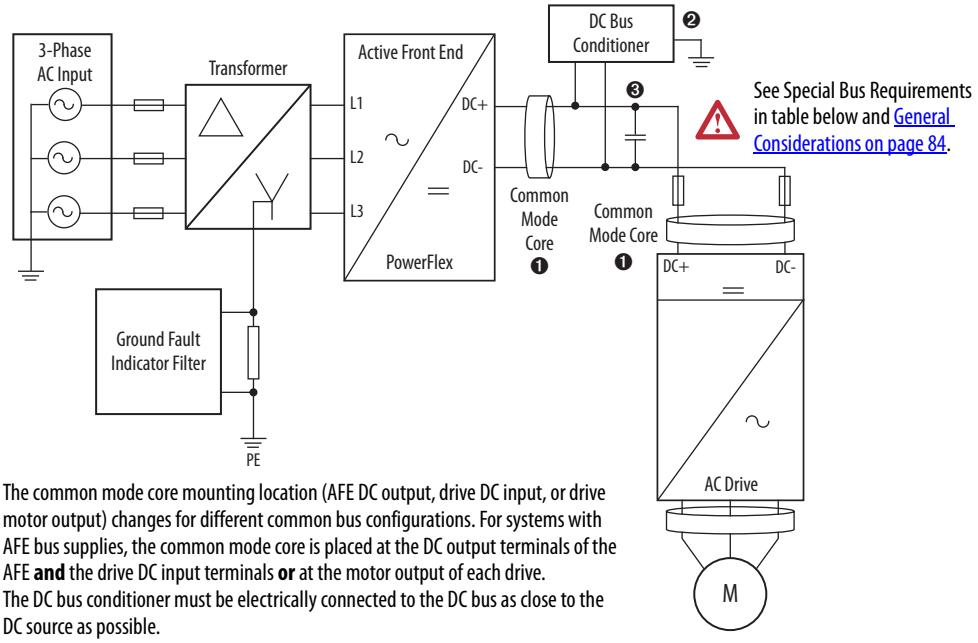
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core [5] | DC Bus Conditioner [8] |
|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty | Frame Size | Qty | Type | | |
| Solid | 400/480 | 1 | 10 [2] or 13 [3] | 2…20 [4] | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design G |
| | 600 [1] | | | | PowerFlex 750-Series: Frames 3 and 4 | | Design G |
| Solid | 400/480 | 1 | 10 [2] or 13 [3] | 2…20 [4] | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design G |
| | 600/690 [1] | | | | | | Design G |
| Solid | 400/480 | 1 | 10 [2] or 13 [3] | 2…20 [4] | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 [6] or 30201-031-01/1321-M670 [7] | Design E |
| | 600/690 | | | | | | Design E |
| Solid | 400/480 | 1 | 10 [2] or 13 [3] | 2…20 [4] | Any other non-listed PowerFlex drive | Contact Factory [4] | |
| | 600/690 | | | | | | |

(1) At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.
(2) For PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.
(3) For PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.
(4) For more than 20 drives, or for any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(5) One common mode core is required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(6) Drive DC input common mode core.
(7) Drive motor output common mode core.
(8) One DC bus conditioner is required for each PowerFlex AFE. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.

## High Resistance Ground System with Single AFE and Single AC Drive

**Figure 45 - High Resistance Ground System with Single AFE and Single AC Drive**




❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core (3) | DC Bus Conditioner (7) | Gnd. Fault Indicator Filter (8) |
|---|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty | Frame Size | Qty | Type | | | |
| High Resistance Ground | 400/480<br>600 | 1 | 10 (1) or 13 (2) | 1 | PowerFlex 750-Series: Frames 1…4<br>PowerFlex 750-Series: Frames 3 and 4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 | 1 | 10 (1) or 13 (2) | 1 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 | 1 | 10 (1) or 13 (2) | 1 | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 (4) or 30201-031-01/1321-M670 (5) | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 | 1 | 10 (1) or 13 (2) | 1 | Any other non-listed PowerFlex drive | Contact Factory (6) | | |

(1) For PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.

(2) For PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.

(3) One common mode core is required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.

(4) Drive DC input common mode core.

(5) Drive motor output common mode core.

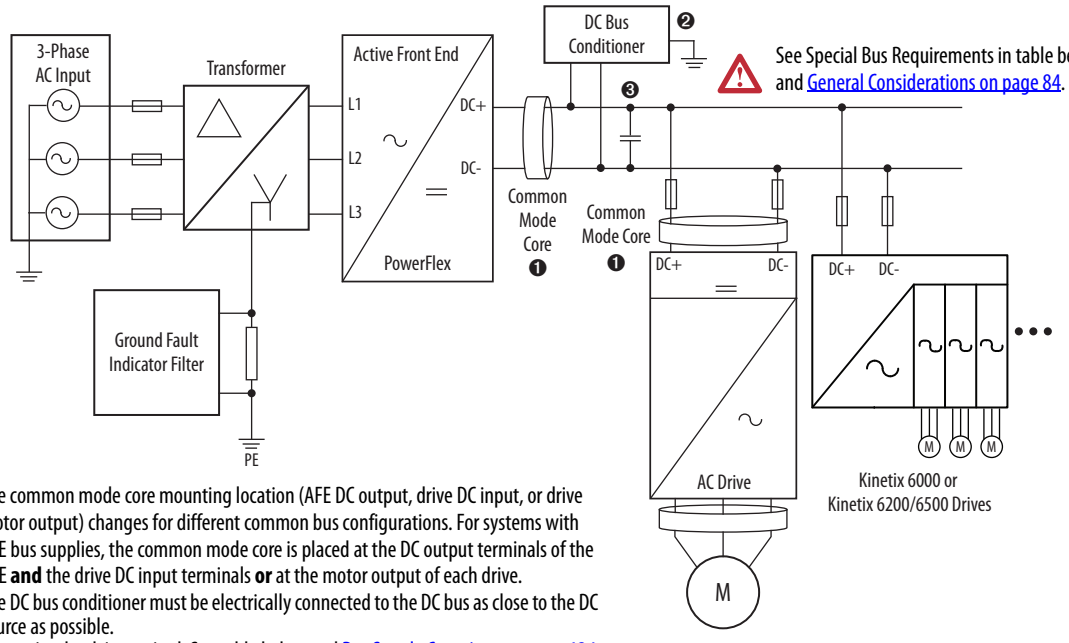
(6) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.

(7) One DC bus conditioner is required for each PowerFlex AFE. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.

(8) See Ground Fault Indicator Filter on page 143 for recommendations.

# High Resistance Ground System with Single AFE and Multiple AC Drives

**Figure 46 - High Resistance Ground System with Single AFE and Multiple AC Drives**




❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

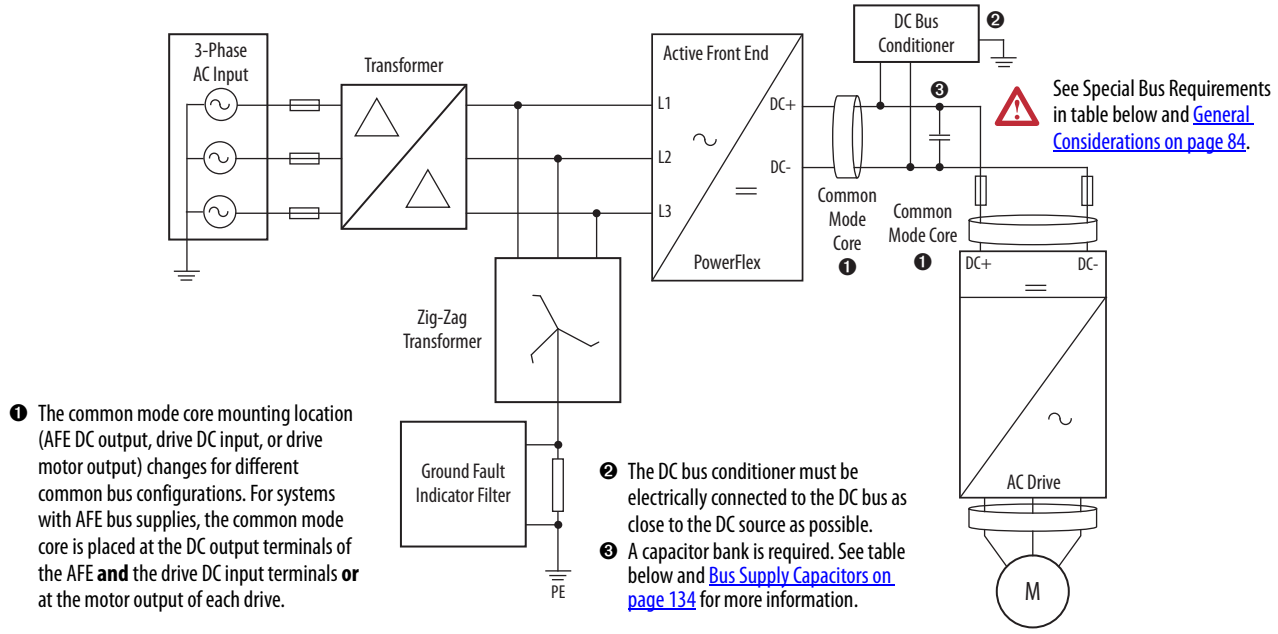
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core (5) | DC Bus Conditioner (8) | Gnd. Fault Indicator Filter (9) |
|---|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty | Frame Size | Qty | Type | | | |
| High Resistance Ground | 400/480<br>600 (1) | 1 | 10 (2) or 13 (3) | 2…20 (4) | PowerFlex 750-Series: Frames 1…4<br>PowerFlex 750-Series: Frames 3 and 4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 (1) | 1 | 10 (2) or 13 (3) | 2…20 (4) | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 | 1 | 10 (2) or 13 (3) | 2…20 (4) | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 (6) or 30201-031-01/1321-M670 (7) | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 | 1 | 10 (2) or 13 (3) | 2…20 (4) | Any other non-listed PowerFlex drive | Contact Factory (4) | | |

(1) At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.
(2) For PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.
(3) For PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.
(4) For more than 20 drives, or for any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(5) One common mode core is required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(6) Drive DC input common mode core.
(7) Drive motor output common mode core.
(8) One DC bus conditioner is required for each PowerFlex AFE. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.
(9) See Ground Fault Indicator Filter on page 143 for recommendations.

## Ungrounded System with Single AFE and Single AC Drive

**Figure 47 - Ungrounded System with Single AFE and Single AC Drive**

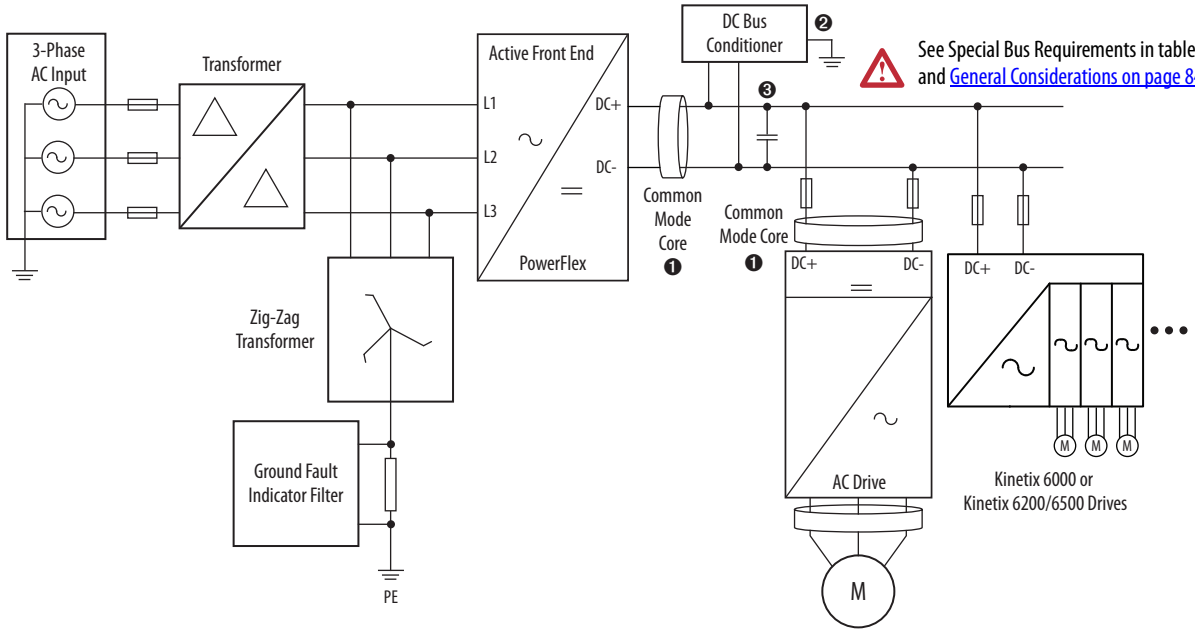

3-Phase AC Input
Transformer
Active Front End
L1
L2
L3
DC+
DC-
PowerFlex
DC Bus Conditioner
❷
❸
See Special Bus Requirements in table below and General Considerations on page 84.
Common Mode Core ❶
Common Mode Core ❶
DC+
DC-
AC Drive
M
Zig-Zag Transformer
Ground Fault Indicator Filter
PE
❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.
❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core (3) | DC Bus Conditioner (7) | Gnd. Fault Indicator Filter (8) | Zig Zag Transformer Required (9) |
|---|---|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty | Frame Size | Qty | Type | | | | |
| Ungrounded | 400/480 | 1 | 10 (1) or 13 (2) | 1 | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design E | Yes | Yes |
| | 600 | | | | PowerFlex 750-Series: Frames 3 and 4 | | | | |
| Ungrounded | 400/480 | 1 | 10 (1) or 13 (2) | 1 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes | Yes |
| | 600/690 | | | | | | | | |
| Ungrounded | 400/480 | 1 | 10 (1) or 13 (2) | 1 | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 (4) or 30201-031-01/1321-M670 (5) | Design E | Yes | Yes |
| | 600/690 | | | | | | | | |
| Ungrounded | 400/480 | 1 | 10 (1) or 13 (2) | 1 | Any other non-listed PowerFlex drive | Contact Factory (6) | | | |
| | 600/690 | | | | | | | | |

(1) For PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.
(2) For PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.
(3) One common mode core is required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(4) Drive DC input common mode core.
(5) Drive motor output common mode core.
(6) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(7) One DC bus conditioner is required for each PowerFlex AFE. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.
(8) See Ground Fault Indicator Filter on page 143 for recommendations.
(9) See Zig-Zag Transformer on page 144 for recommendations.

## Ungrounded System with Single AFE and Multiple AC Drives

**Figure 48 - Ungrounded System with Single AFE and Multiple AC Drives**




❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core (5) | DC Bus Conditioner (8) | Gnd. Fault Indicator Filter (9) | Zig Zag Transformer Required (10) |
|---|---|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty | Frame Size | Qty | Type | | | | |
| Ungrounded | 400/480<br>600 (1) | 1 | 10 (2) or 13 (3) | 2…20 (4) | PowerFlex 750-Series: Frames 1…4<br>PowerFlex 750-Series: Frames 3 and 4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design E | Yes | Yes |
| Ungrounded | 400/480<br>600/690 (1) | 1 | 10 (2) or 13 (3) | 2…20 (4) | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes | Yes |
| Ungrounded | 400/480<br>600/690 | 1 | 10 (2) or 13 (3) | 2…20 (4) | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 (6) or 30201-031-01/1321-M670 (7) | Design E | Yes | Yes |
| Ungrounded | 400/480<br>600/690 | 1 | 10 (2) or 13 (3) | 2…20 (4) | Any other non-listed PowerFlex drive | Contact Factory (4) | | | |

(1) At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.
(2) For PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.
(3) For PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.
(4) For more than 20 drives, or for any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(5) One common mode core required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(6) Drive DC input common mode core.
(7) Drive motor output common mode core.
(8) One conditioner required for each PowerFlex AFE.
(9) See Ground Fault Indicator Filter on page 143 for recommendations.
(10) See Zig-Zag Transformer on page 144 for recommendations.

## General Considerations

1. Disconnect the common mode capacitors from the drives when using a regenerative module. See the drive's documentation for instructions on disconnecting the common mode capacitors.
2. All system components (Bus Supply and PowerFlex Drives) must be selected for the same AC-line voltage.
3. A low inductance type DC bus must be used. See DC Bus Connections on page 15 for details.
4. If a drive from column A in the table below is mixed with a drive from column B, a capacitor bank is required. See Bus Supply Capacitors on page 134 for details.

| Column A Drives | Column B Drives |
|---|---|
| PowerFlex 700/700S: Frames 0…5<br>PowerFlex 750-Series: Frames 1…10<br>Kinetix 6000 and Kinetix 6200/6500<br>Kinetix 7000 | PowerFlex 700/700S: Frame 6<br>PowerFlex 700: Frames 8…10<br>PowerFlex 700H/700S: Frame 9 and up<br>PowerFlex 700L: All Frames |

5. If a disconnect switch between the common DC bus and the drive's input is used, an auxiliary contact on the disconnect switch must be connected to a digital input of the drive. The corresponding digital input must be set to 'Precharge Enable'. This provides the proper precharge interlocking, guarding against possible damage to the drive when reconnecting the drive to an energized DC bus. Under this condition, the drives must have an internal or externally-supplied precharge.

| Drive | Parameter | | Digital Input |
|---|---|---|---|
| | Number | Setting | |
| PowerFlex 40P | A051…A054 | 29 (PreCharge En) | 1…4 |
| PowerFlex 523 | t062…t066 | 30 (PreCharge En) | 2…6 |
| PowerFlex 525 | t062…t068 | 30 (PreCharge En) | 2…8 |
| PowerFlex 700 | 361…366 | 30 (PreCharge En) | 1…6 |
| PowerFlex 700L with vector control | | | |
| PowerFlex 700S | 825…830 | 30 (PreCharge En) | 1…6 |
| PowerFlex 700L with 700S control | | | |
| PowerFlex 700H | 361…366 | 30 (PreCharge En) | 1…6 |
| PowerFlex 750-Series | 189 [DI Precharge] | See Drive Programming Manual for programming information. | |

## Sizing

See the drive documentation for sizing information. In addition, when paralleling PowerFlex AFE units, they must be derated by 5% of their rated power.

# Fusing

## DC Input Drives

See Appendix A for the recommended Common DC Bus drive fusing.

## PowerFlex Active Front End

See the PowerFlex Active Front End User Manual for recommended fusing.

## Notes:

# Multiple Regenerative Bus Supply Configurations

## System Characteristics

The power of the AFE input group can be increased by connecting several groups in parallel. Paralleling refers to AFE units connected on the same input transformer and the same DC bus. The regenerative bus supply puts energy back onto the distribution system instead of dissipating energy with resistor braking technology. This configuration provides low AC line harmonics and can be used to meet IEEE-519 when used with the appropriate filtering.

Paralleling is typically used when the power range of a single frame size is not sufficient, or when redundancy is needed.

## Supported Products

At the time of publication, the following Regenerative Bus Supplies and PowerFlex drives are supported.

| Product | Voltage Class (VAC) | Supported Drives | DC Bus OverVoltage Trip (4) |
|---|---|---|---|
| PowerFlex Active Front End | 400/480 | 480V AC PowerFlex 700 (1) / PowerFlex 700 Series B (1): All Frames (2) | 810V DC |
| | | 480V AC PowerFlex 700S: Frames 1…6 (2) | 810V DC |
| | | 480V AC PowerFlex 750-Series: Frames 1…10 (3) | 810V DC |
| | | 480V AC PowerFlex 700H/700S: Frames 9…14 (2) | 911V DC |
| | 600/690 | 600V AC PowerFlex 750-Series: Frames 3...5 | 1013V DC |
| | | 600V AC PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 0…4 | 1013V DC |
| | | 600/690V AC PowerFlex 700 (1) / PowerFlex 700 Series B (1): Frames 5 and 6 (2) | 1162V DC |
| | | 600/690V AC PowerFlex 700/700S: Frames 5 and 6 (2) | 1162V DC |
| | | 600/690V AC PowerFlex 750-Series: Frame 6…10 | 1172V DC |
| | | 690V AC PowerFlex 700H/700S: Frames 9…14 (2) | 1200V DC |

(1) These drives require firmware revision 2.001 or later (Standard and Vector Control).
(2) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, and PowerFlex 700H Frame 9…14 DC input drives are required when not connected to the AC source.
(3) PowerFlex 750-Series Frame 5…10 DC input version drives with precharge must be selected.
(4) The regenerative limit for the PowerFlex 700AFE must be less than the DC Bus Overload Trip voltage of the drive with the lowest DC Bus Overload Trip voltage.

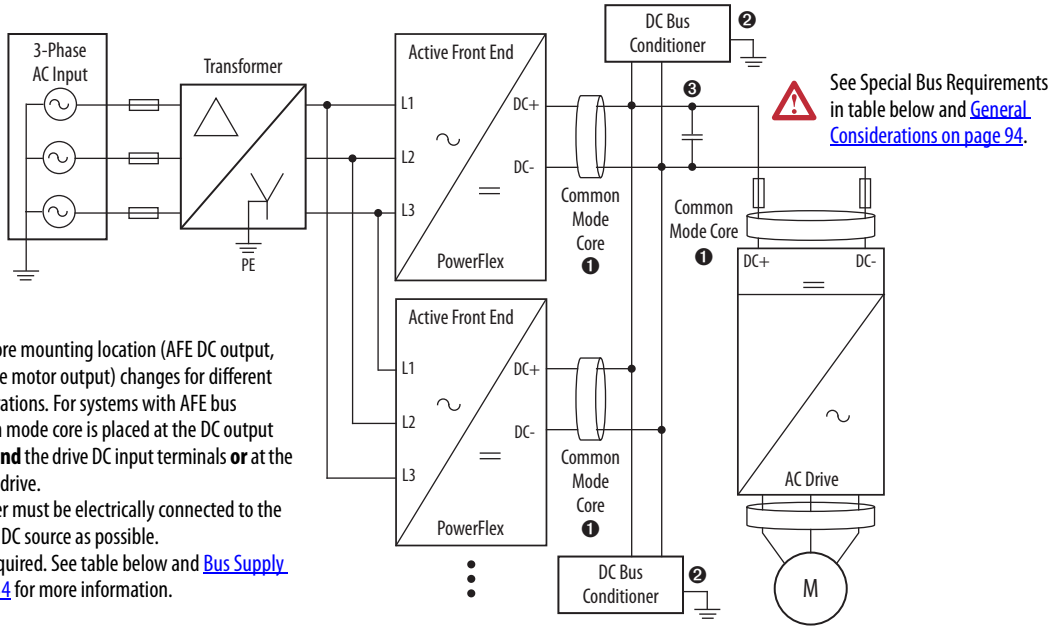
When the PowerFlex AFE is paralleled, the DC bus voltage at regeneration is 5% higher than with a single AFE due to the 5% droop.

# Typical System Configuration

This section is categorized by type of grounding (solid ground, high resistance ground, or ungrounded), multiple AFEs providing power to a single drive, and multiple AFEs providing power to multiple drives.

## Solid Ground System with Multiple AFEs and Single AC Drive

**Figure 49 - Solid Ground System with Multiple AFEs and Single AC Drive**




❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

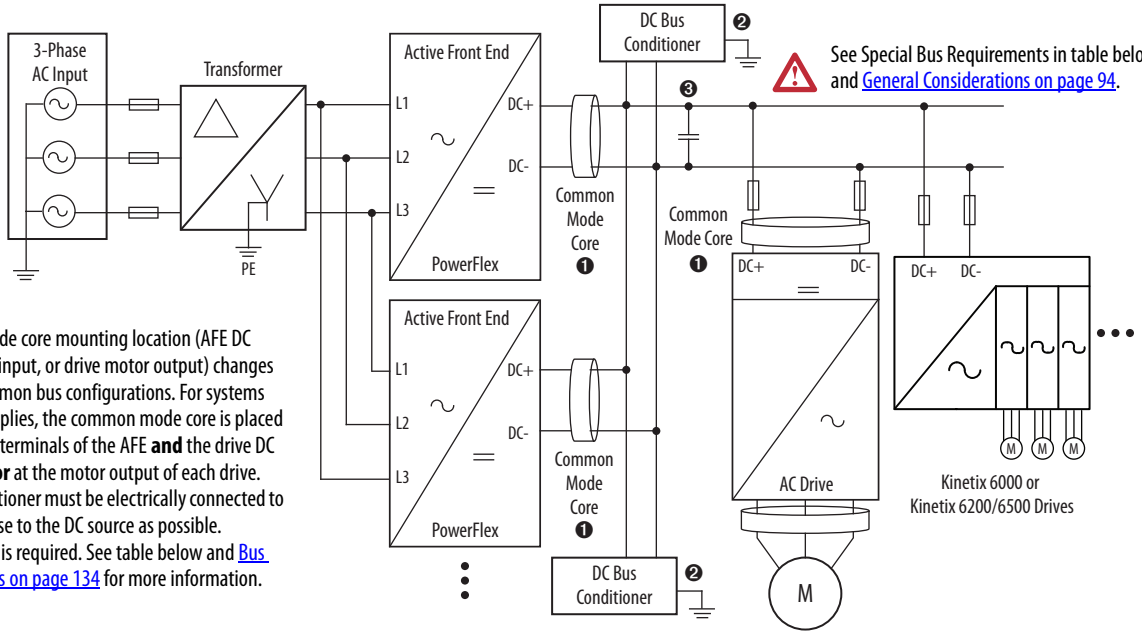
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core (4) | DC Bus Conditioner (8) |
|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty (1) | Frame Size | Qty | Type | | |
| Solid | 400/480 | 2 | 10 (2) or 13 (3) | 1 | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design G |
| | 600 | | | | PowerFlex 750-Series: Frames 3 and 4 | | Design G |
| Solid | 400/480 | 2 | 10 (2) or 13 (3) | 1 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design G |
| | 600/690 | | | | | | Design G |
| Solid | 400/480 | 2 | 10 (2) or 13 (3) | 1 | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 (5) or 30201-031-01/1321-M670 (6) | Design E |
| | 600/690 | | | | | | Design E |
| Solid | 400/480 | 2 | 10 (2) or 13 (3) | 1 | Any other non-listed PowerFlex drive | Contact Factory (7) | |
| | 600/690 | | | | | | |

(1) For quantities greater than 2, contact factory.
(2) For PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.
(3) For PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.
(4) One common mode core is required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(5) Drive DC input common mode core.
(6) Drive motor output common mode core.
(7) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(8) One DC bus conditioner is required for each PowerFlex AFE. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.

## Solid Ground System with Multiple AFEs and Multiple AC Drives

**Figure 50 - Solid Ground System with Multiple AFEs and Multiple AC Drives**




❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

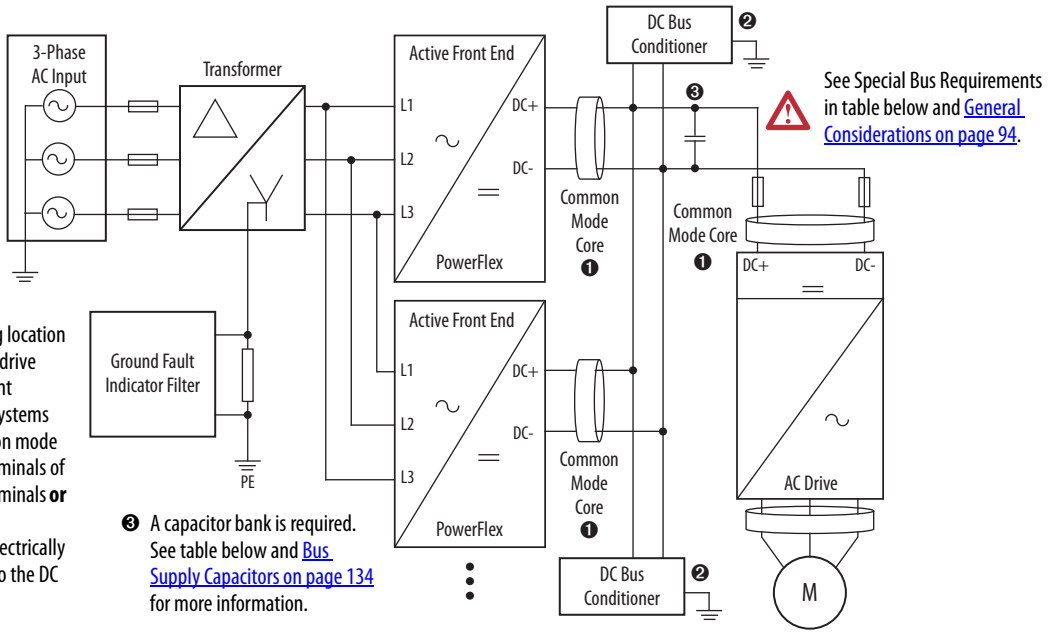
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core (6) | DC Bus Conditioner (9) |
|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty (2) | Frame Size | Qty | Type | | |
| Solid | 400/480 | 2 | 10 (3) or 13 (4) | 2…20 (5) | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design G |
| | 600 (1) | | | | PowerFlex 750-Series: Frames 3 and 4 | | Design G |
| Solid | 400/480 | 2 | 10 (3) or 13 (4) | 2…20 (5) | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design G |
| | 600/690 (1) | | | | | | Design G |
| Solid | 400/480 | 2 | 10 (3) or 13 (4) | 2…20 (5) | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 (7) or 30201-031-01/1321-M670 (8) | Design E |
| | 600/690 | | | | | | Design E |
| Solid | 400/480 | 2 | 10 (3) or 13 (4) | 2…20 (5) | Any other non-listed PowerFlex drive | Contact Factory (5) | |
| | 600/690 | | | | | | |

(1) At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.
(2) For quantities greater than 2, contact factory.
(3) For PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.
(4) For PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.
(5) For more than 20 drives, or for any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(6) One common mode core is required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(7) Drive DC input common mode core.
(8) Drive motor output common mode core.
(9) One DC bus conditioner is required for each PowerFlex AFE. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.

## High Resistance Ground System with Multiple AFEs and Single AC Drive

**Figure 51 - High Resistance Ground System with Multiple AFEs and Single AC Drive**




❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

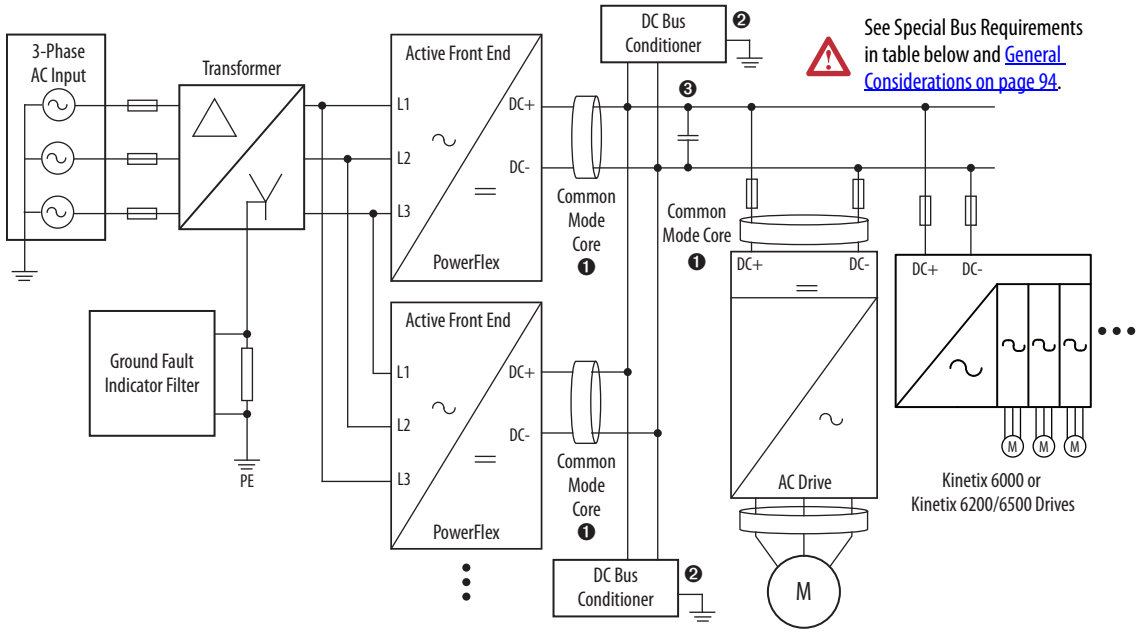
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core (4) | DC Bus Conditioner (8) | Gnd. Fault Indicator Filter (9) |
|---|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty (1) | Frame Size | Qty | Type | | | |
| High Resistance Ground | 400/480<br>600 | 2 | 10 (2) or 13 (3) | 1 | PowerFlex 750-Series: Frames 1…4<br>PowerFlex 750-Series: Frames 3 and 4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 | 2 | 10 (2) or 13 (3) | 1 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 | 2 | 10 (2) or 13 (3) | 1 | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 (5) or 30201-031-01/1321-M670 (6) | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 | 2 | 10 (2) or 13 (3) | 1 | Any other non-listed PowerFlex drive | Contact Factory (7) | | |

(1) For quantities greater than 2, contact factory.
(2) For PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.
(3) For PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.
(4) One common mode core is required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(5) Drive DC input common mode core.
(6) Drive motor output common mode core.
(7) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(8) One DC bus conditioner is required for each PowerFlex AFE. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.
(9) See Ground Fault Indicator Filter on page 143 for recommendations.

## High Resistance Ground System with Multiple AFEs and Multiple AC Drives

**Figure 52 - High Resistance Ground System with Multiple AFEs and Multiple AC Drives**




❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

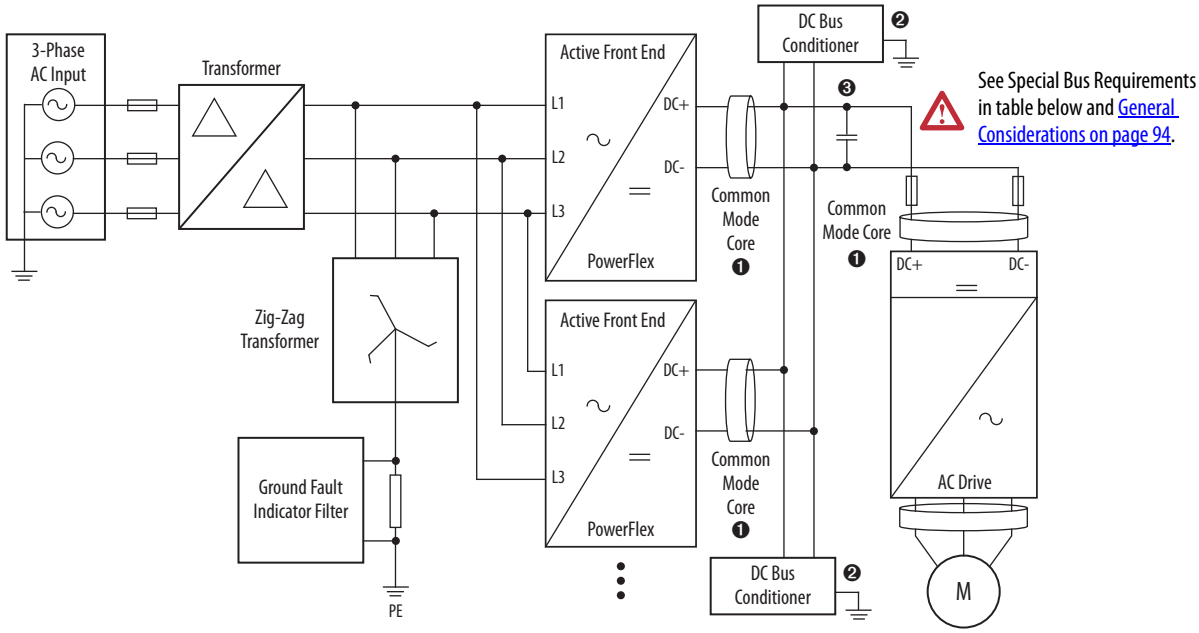
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core (6) | DC Bus Conditioner (9) | Gnd. Fault Indicator Filter (10) |
|---|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty (2) | Frame Size | Qty | Type | | | |
| High Resistance Ground | 400/480<br>600 (1) | 2 | 10 (3) or 13 (4) | 2…20 (5) | PowerFlex 750-Series: Frames 1…4<br>PowerFlex 750-Series: Frames 3 and 4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 (1) | 2 | 10 (3) or 13 (4) | 2…20 (5) | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 | 2 | 10 (3) or 13 (4) | 2…20 (5) | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 (7) or 30201-031-01/1321-M670 (8) | Design E | Yes |
| High Resistance Ground | 400/480<br>600/690 | 2 | 10 (3) or 13 (4) | 2…20 (5) | Any other non-listed PowerFlex drive | Contact Factory (5) | | |

(1) At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.
(2) For quantities greater than 2, contact factory.
(3) For PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.
(4) For PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.
(5) For more than 20 drives, or for any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(6) One common mode core is required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(7) Drive DC input common mode core.
(8) Drive motor output common mode core.
(9) One DC bus conditioner is required for each PowerFlex AFE. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.
(10) See Ground Fault Indicator Filter on page 143 for recommendations.

## Ungrounded System with Multiple AFEs and Single AC Drive

**Figure 53 - Ungrounded System with Multiple AFEs and Single AC Drive**




❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

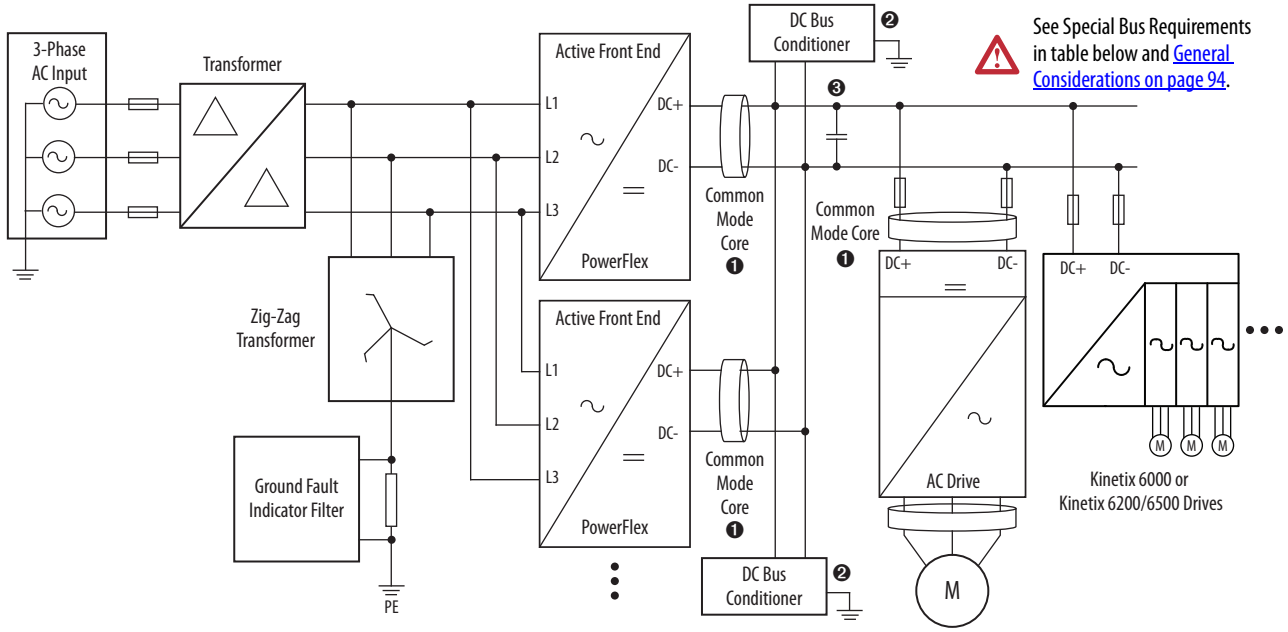
❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core (4) | DC Bus Conditioner (8) | Gnd. Fault Indicator Filter (9) | Zig Zag Transformer Required (10) |
|---|---|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty (1) | Frame Size | Qty | Type | | | | |
| Ungrounded | 400/480 | 2 | 10 (2) or 13 (3) | 1 | PowerFlex 750-Series: Frames 1…4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design E | Yes | Yes |
| | 600 | | | | PowerFlex 750-Series: Frames 3 and 4 | | | | |
| Ungrounded | 400/480 | 2 | 10 (2) or 13 (3) | 1 | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes | Yes |
| | 600/690 | | | | | | | | |
| Ungrounded | 400/480 | 2 | 10 (2) or 13 (3) | 1 | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 (5) or 30201-031-01/1321-M670 (6) | Design E | Yes | Yes |
| | 600/690 | | | | | | | | |
| Ungrounded | 400/480 | 2 | 10 (2) or 13 (3) | 1 | Any other non-listed PowerFlex drive | Contact Factory (7) | | | |
| | 600/690 | | | | | | | | |

(1) For quantities greater than 2, contact factory.
(2) For PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.
(3) For PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.
(4) One common mode core is required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(5) Drive DC input common mode core.
(6) Drive motor output common mode core.
(7) For any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(8) One DC bus conditioner is required for each PowerFlex AFE. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.
(9) See Ground Fault Indicator Filter on page 143 for recommendations.
(10) See Zig-Zag Transformer on page 144 for recommendations.

## Ungrounded System with Multiple AFEs and Multiple AC Drives

**Figure 54 - Ungrounded System with Multiple AFEs and Multiple AC Drives**




❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible.

❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| System | | AFE | | Drive | | Common Mode Core (6) | DC Bus Conditioner (9) | Gnd. Fault Indicator Filter (10) | Zig Zag Transformer Required (11) |
|---|---|---|---|---|---|---|---|---|---|
| Ground Type | Voltage | Qty (2) | Frame Size | Qty | Type | | | | |
| Ungrounded | 400/480<br>600 (1) | 2 | 10 (3) or 13 (4) | 2…20 (5) | PowerFlex 750-Series: Frames 1…4<br>PowerFlex 750-Series: Frames 3 and 4 | Fr. 1…3: 1321-M048<br>Fr. 4: 1321-M180 | Design e | Yes | Yes |
| Ungrounded | 400/480<br>600/690 (1) | 2 | 10 (3) or 13 (4) | 2…20 (5) | PowerFlex 750-Series: Frames 5 and 6<br>PowerFlex 750-Series: Frames 7<br>PowerFlex 750-Series: Frames 8…10 | Fr. 5…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: Included with drives with enclosure 'P' or 'W' and Input Type 4. Also, see Note 1 on page 25 for catalog no. information. | Design E | Yes | Yes |
| Ungrounded | 400/480<br>600/690 | 2 | 10 (3) or 13 (4) | 2…20 (5) | PowerFlex 700H/700S: Frames 9…14 | Contact factory for 30339-319-01 (7) or 30201-031-01/1321-M670 (8) | Design E | Yes | Yes |
| Ungrounded | 400/480<br>600/690 | 2 | 10 (3) or 13 (4) | 2…20 (5) | Any other non-listed PowerFlex drive | Contact Factory (5) | | | |

(1) At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750 Series Frame 6…10 drives.
(2) For quantities greater than 2, contact factory.
(3) for PowerFlex AFE Frame 10, use common mode core 30339-320-01 at the AFE output terminals.
(4) for PowerFlex AFE Frame 13, use common mode core 30339-319-01 at the AFE output terminals.
(5) For more than 20 drives, or for any non-listed PowerFlex drive, contact the factory. See Technical Support (SupportPlus™) on page 14 for details.
(6) One common mode core is required on each PowerFlex AFE output. See Note 1 in the diagram above and Common Mode Core on page 136 for recommendations.
(7) Drive DC input common mode core.
(8) Drive motor output common mode core.
(9) One DC bus conditioner is required for each PowerFlex AFE. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.
(10) See Ground Fault Indicator Filter on page 143 for recommendations.
(11) See Zig-Zag Transformer on page 144 for recommendations.

## PowerFlex Active Front End Considerations

See the PowerFlex Active Front End User Manual for AFE considerations.

## General Considerations

1. Disconnect the common mode capacitors from the drives when using a regenerative module. See the drive's documentation for instructions on disconnecting the common mode capacitors.
2. All system components (Bus Supply and PowerFlex Drives) must be selected for the same AC-line voltage.
3. A low inductance type DC bus must be used. See DC Bus Connections on page 15 for details.
4. If a disconnect switch between the common DC bus and the drive's input is used, an auxiliary contact on the disconnect switch must be connected to a digital input of the drive. The corresponding digital input must be set to 'Precharge Enable'. This provides the proper precharge interlocking, guarding against possible damage to the drive when reconnecting the drive to an energized DC bus. Under this condition, the drives must have internal or externally-supplied precharge.

| Drive | Parameter | | Digital Input |
|---|---|---|---|
| | Number | Setting | |
| PowerFlex 40P | A051…A054 | 29 (PreCharge En) | 1…4 |
| PowerFlex 523 | t062…t066 | 30 (PreCharge En) | 2…6 |
| PowerFlex 525 | t062…t068 | 30 (PreCharge En) | 2…8 |
| PowerFlex 700 | 361…366 | 30 (PreCharge En) | 1…6 |
| PowerFlex 700L with vector control | | | |
| PowerFlex 700S | 825…830 | 30 (PreCharge En) | 1…6 |
| PowerFlex 700L with 700S control | | | |
| PowerFlex 700H | 361…366 | 30 (PreCharge En) | 1…6 |
| PowerFlex 750-Series | 189 [DI Precharge] | See Drive Programming Manual for programming information. | |

5. If a drive from column A in the table below is mixed with a drive from column B, a capacitor bank is required. See Bus Supply Capacitors on page 134 for details.

| Column A Drives | Column B Drives |
|---|---|
| PowerFlex 700/700S: Frames 0…5<br>PowerFlex 750-Series: Frames 1…10<br>Kinetix 6000 and Kinetix 6200/6500<br>Kinetix 7000 | PowerFlex 700/700S: Frame 6<br>PowerFlex 700: Frames 8…10<br>PowerFlex 700H/700S: Frame 9 and up<br>PowerFlex 700L: All Frames |

## Sizing

See the drive documentation for sizing information. In addition, when paralleling PowerFlex 700AFE units, they must be derated by 5% of their power rating.

# Fusing

## DC Input Drives

See Appendix A for the recommended Common DC Bus drive fusing.

## PowerFlex Active Front End

See the PowerFlex Active Front End User Manual for recommended fusing.

## Notes:

# Paralleling Regenerative Bus Supplies (AFEs) with One or More Non-Regenerative PowerFlex SCR Bus Supplies

## System Characteristics

One or more AFEs can be paralleled with one or more PowerFlex SCR Bus Supplies for applications that require partial regeneration capacity.

The AFE component of this system is characterized by a PWM-controlled IGBT converter for full regeneration of power to the AC line. The regenerative bus supply puts energy back onto the distribution system instead of dissipating energy with resistor braking technology. This configuration provides low AC line harmonics and can be used to meet IEEE-519 when used with the appropriate filtering.

The SCR bus supply component of this system is characterized by an SCR rectifier front end, which converts the 3-phase AC line voltage into a non-filtered DC bus voltage.

## Supported Products

At the time of publication, the following products are supported.

| Products | Supported Drives |
|---|---|
| PowerFlex Active Front End in parallel with PowerFlex SCR Bus Supply | PowerFlex 40P: All power ratings |
| | PowerFlex520-Series: All power ratings - Three phase only |
| | PowerFlex 700 (1) / PowerFlex 700 Series B (1): All frame sizes (2) |
| | PowerFlex 700S: All frame sizes (2) |
| | PowerFlex 700H: All frame sizes (2) |
| | PowerFlex 700L: Frames 3A (3) and 3B (2) |
| | PowerFlex 750-Series: Frames 1…10 (4) |
| | Kinetix 7000: BM06…BM12 |
| | Kinetix 6000 and Kinetix 6200/6500: All 460V configurations |

(1) These drives require firmware revision 2.001 or later (Standard and Vector Control).

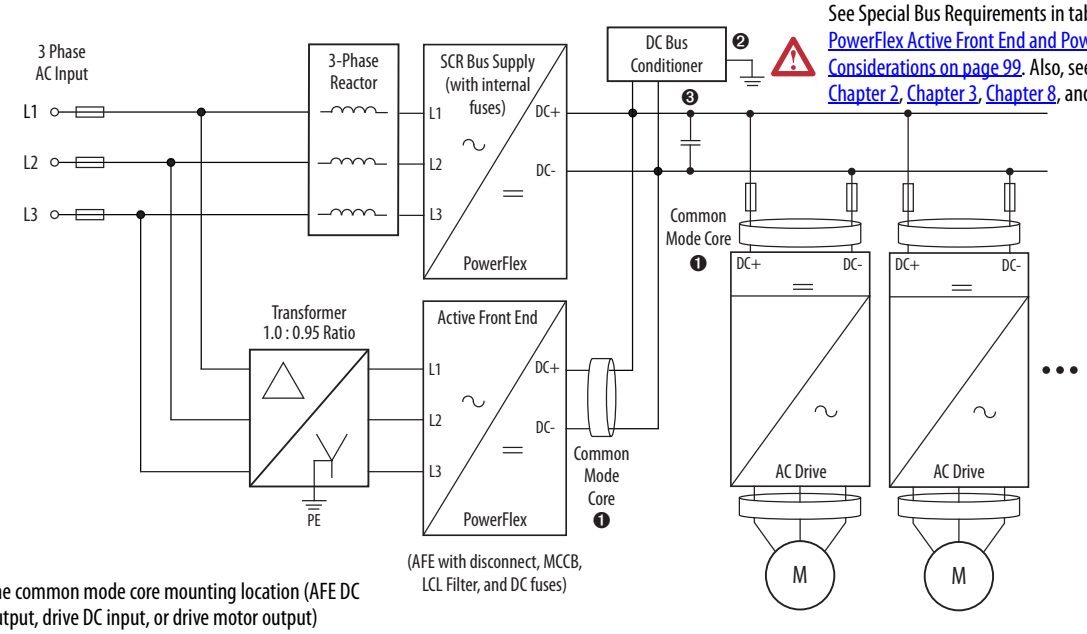
(2) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.

(3) Frame 3A dual inverter drives only.

(4) PowerFlex 750-Series Frame 5…7 DC input version drives with precharge must be selected.

# Typical System Configuration

**Figure 55 - AFE in Parallel with PowerFlex SCR Bus Supply with AC Drives**




See Special Bus Requirements in table below and PowerFlex Active Front End and PowerFlex SCR Bus Supply Considerations on page 99. Also, see all information in Chapter 2, Chapter 3, Chapter 8, and Chapter 9.

❶ The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of the AFE **and** the drive DC input terminals **or** at the motor output of each drive.

❷ The DC bus conditioner must be electrically connected to the DC bus as close to the DC source as possible. See DC Bus Conditioner—Designs A, B, C, D, or E on page 139 for details.

❸ A capacitor bank is required. See table below and Bus Supply Capacitors on page 134 for more information.

| Drawing Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive | PowerFlex 700/700S: Frames 0…4 | At 600 volts, PowerFlex 700/700S Frame 0…4 drives cannot be used on the same bus as PowerFlex 700/700S Frame 5 and 6 drives. |
| | PowerFlex 750-Series: Frames 1…4 | At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives. |
| | PowerFlex 700/700S: Frames 5 and 6 | • Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used.<br>• At 600 volts, PowerFlex 700/700S Frame 0…4 drives cannot be used on the same bus as PowerFlex 700/700S Frame 5 and 6 drives.<br>• DC input 'common bus' drives are required—not AC stand-alone configuration. |
| | PowerFlex 700: Frames 7…10 | • Additional bus capacitance may be required. See General Considerations on page 99.<br>• External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used.<br>• DC input 'common bus' drives are required—not AC stand-alone configuration. |
| | PowerFlex 700H/700S: Frames 9 …14 | |
| | PowerFlex 700L: Frames 3A (1) and 3B | |
| | PowerFlex 750-Series: Frames 5…10 | • At 600 volts, PowerFlex 750-Series Frame 3…5 drives cannot be used on the same bus as PowerFlex 750-Series Frame 6…10 drives.<br>• DC input drive with precharge must be selected (input type code = 4). |
| | Kinetix 7000: BM06…BM08 | None |
| | Kinetix 7000: BM09…BM12 | External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. |
| | PowerFlex 40P: All power ratings | **Important:** Do not use PowerFlex 40P or PowerFlex 520-Series drives on the same DC bus supply with PowerFlex 700/700H/700S drives or Kinetix 7000 drives. This is due to the difference in capacitance/amp of the PowerFlex 40P or PowerFlex 520-Series drives compared to the PowerFlex 700/700H/700S drives and Kinetix 7000 drives. |
| | PowerFlex520-Series: All power ratings - Three phase only | |

(1) Frame 3A dual inverter drives only.

## PowerFlex Active Front End and PowerFlex SCR Bus Supply Considerations

- An isolating delta Y transformer with the secondary center tap ungrounded must be used on the input of the AFE (see Figure 55 on page 98). This minimizes circulating currents and avoids nuisance ground faults in the AFE.
- The transformer kVA must be equal to or greater than the AFE input kVA.
- The system impedance must be less than 10%.
- The isolating transformer on the input of the AFE must be tapped 5% below the input voltage for the PowerFlex SCR Bus Supply. This provides proper sharing of the load between the AFE and SCR Bus Supply during motoring operation.
- An input reactor must be used on the input of each PowerFlex SCR Bus Supply. See the PowerFlex SCR Bus Supply User Manual for details.
- Set SCR Bus Supply jumper to 'AFE' mode. See SCR Bus Supply User Manual, publication 20S-UM001 for details.
- Let the PowerFlex SCR Bus Supply precharge the DC bus of the system before letting the AFE complete its precharge and close its MCCB. See the PowerFlex SCR Bus Supply User Manual for details on setting up the precharge rate.
- Parameter 75 - [Motor Power Lmt] of the AFE must be set to 10% to limit the motoring current that the AFE can supply and avoid overload faults on the AFE.

## General Considerations

1. Disconnect the common mode capacitors from the drives when using a regenerative module. See the drive's documentation for instructions on disconnecting the common mode capacitors.
2. All system components (Bus Supply and PowerFlex Drives) must be selected for the same AC-line voltage.
3. A low inductance type DC bus must be used. See for DC Bus Connections on page 15 details.
4. If a disconnect switch between the common DC bus and the drive's input is used, an auxiliary contact on the disconnect switch must be connected to a digital input of the drive. The corresponding digital input must be set to 'Precharge Enable'. This provides the proper precharge interlocking, guarding against possible damage to the drive when reconnecting the drive to an energized DC bus. Under this condition, the drives must have internal or externally-supplied precharge.

| Drive | Parameter | | Digital Input |
|---|---|---|---|
| | Number | Setting | |
| PowerFlex 40P | A051…A054 | 29 (PreCharge En) | 1…4 |
| PowerFlex 523 | t062…t066 | 30 (PreCharge En) | 2…6 |
| PowerFlex 525 | t062…t068 | 30 (PreCharge En) | 2…8 |
| PowerFlex 700 | 361…366 | 30 (PreCharge En) | 1…6 |
| PowerFlex 700L with vector control | | | |
| PowerFlex 700S | 825…830 | 30 (PreCharge En) | 1…6 |
| PowerFlex 700L with 700S control | | | |
| PowerFlex 700H | 361…366 | 30 (PreCharge En) | 1…6 |
| PowerFlex 750-Series | 189 [DI Precharge] | See Drive Programming Manual for programming information. | |

5. If a drive from column A in the table below is mixed with a drive from column B, a capacitor bank is required. See Bus Supply Capacitors on page 134 for details.

| Column A Drives | Column B Drives |
|---|---|
| PowerFlex 700/700S: Frames 0…5<br>PowerFlex 750-Series: Frames 1…10<br>Kinetix 6000 and Kinetix 6200/6500<br>Kinetix 7000 | PowerFlex 700/700S: Frame 6<br>PowerFlex 700: Frames 8…10<br>PowerFlex 700H/700S: Frame 9 and up<br>PowerFlex 700L: All Frames |

## Sizing

See the drive documentation for sizing the AFE. See Chapter 2 for sizing the SCR Bus Supply. In addition, the AFE must be sized for the regenerative power only, and the SCR Bus Supply must be sized to handle all of the motoring power because the AFE is programmed for a 10% [Motor Power Lmt].

## Fusing

### DC Input Drives

See Appendix A for the recommended Common DC Bus drive fusing.

### PowerFlex SCR Bus Supply

The PowerFlex SCR Bus Supply has built-in AC line and DC bus fuses (on 400A and 600A units). The 1000A unit has six in-path fuses which simultaneously protect AC and DC paths. All units are equipped with fuse trip indicator switches. See the PowerFlex SCR Bus Supply User Manual for fusing information.

### PowerFlex Active Front End

See the PowerFlex Active Front End User Manual for recommended fusing.

# PowerFlex Drive Ratings, Recommended DC Bus Fuses, and Drive DC Bus Capacitance

The tables on the following pages provide drive ratings (including DC input currents), recommended DC input fuses (Manufacturer Catalog No.), and internal drive DC bus capacitance. The sizes listed are the recommended sizes based on 40 °C. If available amp ratings do not match the tables provided, the closest fuse rating that exceeds the drive rating should be chosen.

## 325 Volt DC Input Fuses

**Table 1 - PowerFlex 40P Drives, 325V DC Input Fuses**

| Drive Cat. No. 22D… | HP Rating | DC Input Amps | Non-Time Delay Fuse (1) | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|
| | | | Amps | Catalog No. | |
| B2P3 | 0.5 | 2.1 | 6 | Bussmann JKS-6 (2) | 270 |
| B5P0 | 1 | 4.5 | 10 | Bussmann JKS-10 (2) | 560 |
| B8P0 | 2 | 8.1 | 20 | Ferraz Shawmut HSJ20 (3) | 940 |
| B012 | 3 | 12.1 | 25 | Ferraz Shawmut HSJ25 (3) | 1,120 |
| B017 | 5 | 18.3 | 40 | Ferraz Shawmut HSJ40 (3) | 2,000 |
| B024 | 7.5 | 25.4 | 50 | Ferraz Shawmut HSJ50 (3) | 2,800 |
| B033 | 10 | 35.4 | 70 | Ferraz Shawmut HSJ70 (3) | 3,920 |

(1) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects:* Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses:* Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(2) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(3) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 2 - PowerFlex 520-Series Drives, 325V DC Input Fuses**

| Drive Cat. No. 25x [1] | HP Rating | | DC Input Amps | Non-Time Delay Fuse [3] | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|
| | ND | HD | | Amps | Catalog No. | |
| B1P6 [2] | 0.25 | 0.25 | 1.5 | 3 | Bussmann JKS-3 [4] | 150 |
| B2P5 | 0.5 | 0.5 | 2.3 | 6 | Bussmann JKS-6 [4] | 270 |
| B5P0 | 1.0 | 1.0 | 4.6 | 10 | Bussmann JKS-10 [4] | 470 |
| B8P0 | 2.0 | 2.0 | 8.2 | 20 | Ferraz Shawmut HSJ20 [5] | 776 |
| B011 | 3.0 | 3.0 | 11.3 | 25 | Ferraz Shawmut HSJ25 [5] | 1122 |
| B017 | 5.0 | 5.0 | 18.6 | 40 | Ferraz Shawmut HSJ40 [5] | 1680 |
| B024 | 7.5 | 7.5 | 25.9 | 50 | Ferraz Shawmut HSJ50 [5] | 2232 |
| B032 | 10.0 | 10.0 | 35.1 | 70 | Ferraz Shawmut HSJ70 [5] | 3349 |
| B048 | 15.0 | 15.0 | 53.3 | 80 | Ferraz Shawmut HSJ80 [5] | 3912 |
| B062 | 20.0 | 15.0 | 69.3 | 100 | Ferraz Shawmut HSJ100 [5] | 5030 |

(1) The drive catalog number prefix is 25A for PowerFlex 523 drives, and 25B for PowerFlex 525 drives.

(2) PowerFlex 523 drive only.

(3) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects*: Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses:* Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(4) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(5) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 3 - PowerFlex 700/700S Drives — Frames 0…6, 325V DC Input Fuses**

| Drive Cat. No. 20B… / 20D… | Frame Size | HP Rating | | DC Input Rating | Non-Time Delay Fuse (2) | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | |
| B2P2 | 0 | 0.5 | 0.33 | 2.0 | 6 | Bussmann JKS-6 (3) | 440 |
| B4P2 | 0/1 | 1 | 0.75 | 3.8 | 8 | Bussmann JKS-8 (3) | 440 |
| B6P8 | 1 | 2 | 1.5 | 6.9 | 15 | Ferraz Shawmut HSJ15 (4) | 1,120 |
| B9P6 | 1 | 3 | 2 | 9.7 | 20 | Ferraz Shawmut HSJ20 (4) | 1,120 |
| B015 | 1 | 5 | 3 | 16 | 30 | Ferraz Shawmut HSJ30 (4) | 2,000 |
| B022 | 1 | 7.5 | 5 | 23.3 | 45 | Ferraz Shawmut HSJ45 (4) | 2,000 |
| B028 | 2 | 10 | 7.5 | 30 | 60 | Ferraz Shawmut HSJ60 (4) | 3,000 |
| B042 | 3 | 15 | 10 | 45 | 90 | Ferraz Shawmut HSJ90 (4) | 4,800 |
| B052 | 3 | 20 | 15 | 55 | 100 | Ferraz Shawmut HSJ100 (4) | 4,800 |
| B070 | 4 | 25 | 20 | 75.3 | 150 | Ferraz Shawmut HSJ150 (4) | 7,000 |
| B080 | 4 | 30 | 25 | 85.8 | 175 | Ferraz Shawmut HSJ175 (4) | 7,000 |
| N104 (1) | 5 | 40 | 30 | 114.1 | 225 | Ferraz Shawmut HSJ225 (4) | 9,000 |
| N130 (1) | 5 | 50 | 40 | 142.6 | 250 | Ferraz Shawmut HSJ250 (4) | 12,000 |
| N154 (1) | 6 | 60 | 50 | 169 | 300 | Ferraz Shawmut HSJ300 (4) | 13,800 |
| N192 (1) | 6 | 75 | 60 | 210.6 | 400 | Ferraz Shawmut HSJ400 (4) | 16,800 |
| N260 (1) | 6 | 100 | 75 | 272.1 | 400 | Ferraz Shawmut HSJ400 (4) | 16,800 |

(1) Catalog number corresponds to drives with precharge only.

(2) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects*: Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses:* Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(3) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(4) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

## 540 Volt DC Input Fuses

**Table 4 - PowerFlex 40P Drives, 540V DC Input Fuses**

| Drive Cat. No. 22D… | kW Rating | DC Input Amps | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|
| | | | Amps | Catalog No. | |
| D1P4 | 0.4 | 1.4 | 3 | Bussmann JKS-3 (1) | 90 |
| D2P3 | 0.75 | 2.2 | 6 | Bussmann JKS-6 (1) | 135 |
| D4P0 | 1.5 | 4.1 | 10 | Bussmann JKS-10 (1) | 235 |
| D6P0 | 2.2 | 6.4 | 15 | Ferraz Shawmut HSJ15 (2) | 280 |
| D010 | 4 | 11.6 | 25 | Ferraz Shawmut HSJ25 (2) | 600 |
| D012 | 5.5 | 13.4 | 25 | Ferraz Shawmut HSJ25 (2) | 705 |
| D017 | 7.5 | 19.4 | 40 | Ferraz Shawmut HSJ40 (2) | 940 |
| D024 | 11 | 28.0 | 50 | Ferraz Shawmut HSJ50 (2) | 1,120 |

(1) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(2) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 5 - PowerFlex 520-Series Drives, 540V DC Input Fuses**

| Drive Cat. No. 25x [1] | kW Rating | | DC Input Amps | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|
| | ND | HD | | Amps | Catalog No. | |
| D1P4 | 0.4 | 0.4 | 1.3 | 3 | Bussmann JKS-3 [2] | 74 |
| D2P3 | 0.75 | 0.75 | 2.2 | 6 | Bussmann JKS-6 [2] | 108 |
| D4P0 | 1.5 | 1.5 | 3.8 | 8 | Bussmann JKS-8 [2] | 192 |
| D6P0 | 2.2 | 2.2 | 5.7 | 15 | Ferraz Shawmut HSJ15 [3] | 282 |
| D010 | 4.0 | 4.0 | 11.1 | 25 | Ferraz Shawmut HSJ25 [3] | 557 |
| D013 | 5.5 | 5.5 | 13.8 | 30 | Ferraz Shawmut HSJ30 [3] | 676 |
| D017 | 7.5 | 7.5 | 18.7 | 40 | Ferraz Shawmut HSJ40 [3] | 816 |
| D024 | 11.0 | 11.0 | 26.7 | 50 | Ferraz Shawmut HSJ50 [3] | 1200 |
| D030 | 15.0 | 11.0 | 33.7 | 50 | Ferraz Shawmut HSJ50 [3] | 1500 |
| D037 | 18.5 | 15.0 | 42.1 | 70 | Ferraz Shawmut HSJ70 [3] | 1399 |
| D043 | 22.0 | 18.5 | 49.5 | 80 | Ferraz Shawmut HSJ80 [3] | 1699 |

(1) The drive catalog number prefix is 25A for PowerFlex 523 drives, and 25B for PowerFlex 525 drives.

(2) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(3) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 6 - PowerFlex 700/700S Drives — Frames 0…6, 540V DC Input Fuses**

| Drive Cat. No. 20B… / 20D… | Frame Size | kW Rating | | DC Input Rating | Non-Time Delay Fuse[2] | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | |
| C1P3 | 0 | 0.37 | 0.25 | 1.3 | 3 | Bussmann JKS-3 [3] | 110 |
| C2P1 | 0/1 | 0.75 | 0.55 | 2.1 | 6 | Bussmann JKS-6 [3] | 110 |
| C3P5 | 0/1 | 1.5 | 1.1 | 3.7 | 8 | Bussmann JKS-8 [3] | 165 |
| C5P0 | 0/1 | 2.2 | 1.5 | 5.3 | 10 | Bussmann JKS-10 [3] | 280 |
| C8P7 | 0/1 | 4 | 3.0 | 9.3 | 15 | Ferraz Shawmut HSJ15 [4] | 330 |
| C011 | 0/1 | 5.5 | 4 | 12.6 | 20 | Ferraz Shawmut HSJ20 [4] | 560 |
| C015 | 1 | 7.5 | 5.5 | 16.8 | 25 | Ferraz Shawmut HSJ25 [4] | 680 |
| C022 | 1 | 11 | 7.5 | 24 | 40 | Ferraz Shawmut HSJ40 [4] | 1,000 |
| C030 | 2 | 15 | 11 | 33.2 | 50 | Ferraz Shawmut HSJ50 [4] | 1,200 |
| C037 | 2 | 18.5 | 15 | 40.9 | 70 | Ferraz Shawmut HSJ70 [4] | 1,500 |
| C043 | 3 | 22 | 18.5 | 47.5 | 90 | Ferraz Shawmut HSJ90 [4] | 1,800 |
| C056 | 3 | 30 | 22 | 61.9 | 100 | Ferraz Shawmut HSJ100 [4] | 2,400 |
| C072 | 3 | 37 | 30 | 80.5 | 125 | Ferraz Shawmut HSJ125 [4] | 3,000 |
| C085 | 4 | 45 | 37 | 95.1 | 150 | Ferraz Shawmut HSJ150 [4] | 3,500 |
| H105 [1] | 5 | 55 | — | 120.2 | 175 | Ferraz Shawmut HSJ175 [4] | 4,500 |
| | | — | 45 | 95.1 | 175 | Ferraz Shawmut HSJ175 [4] | |
| H125 [1] | 5 | 55 | — | 120.2 | 200 | Ferraz Shawmut HSJ200 [4] | 6,000 |
| | | — | 45 | 95.1 | 200 | Ferraz Shawmut HSJ200 [4] | |
| H140 [1] | 5 | 75 | — | 159 | 250 | Ferraz Shawmut HSJ250 [4] | 6,000 |
| | | — | 55 | 120.2 | 250 | Ferraz Shawmut HSJ250 [4] | |
| H170 [1] | 6 | 90 | — | 192 | 350 | Ferraz Shawmut HSJ350 [4] | 6,900 |
| | | — | 75 | 159 | 350 | Ferraz Shawmut HSJ350 [4] | |
| H205 [1] | 6 | 110 | — | 226 | 350 | Ferraz Shawmut HSJ350 [4] | 8,400 |
| | | — | 90 | 192 | 350 | Ferraz Shawmut HSJ350 [4] | |
| H260 [1] | 6 | 132 | — | 298 | 400 | Ferraz Shawmut HSJ400 [4] | 8,400 |
| | | — | 110 | 226 | 400 | Ferraz Shawmut HSJ400 [4] | |

(1) Also applies to 'P' voltage class. Fuses must be applied in the (+) leg and (-) leg of the DC Common Bus.

(2) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects*: Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses*: Bussmann Type JKS, all sizes; Type 170M, Case Sizes 1, 2 and 3, or Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(3) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(4) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 7 - PowerFlex 700 Drives — Frames 7…10, 540V DC Input Fuses**

| Drive Cat. No. 20B… | Frame Size | kW Rating | | DC Input Rating | | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | kW | Amps | Catalog No. | |
| P292 | 7 | 160 | — | 342 | 185 | 630 | Bussmann 170M6608 (3) | 15,000 |
| | | — | 150 | 309 | 166 | 630 | Bussmann 170M6608 (3) | |
| P325 | 7 | 180 | — | 381 | 206 | 800 | Bussmann 170M6612 (3) | 15,000 |
| | | — | 180 | 381 | 206 | 800 | Bussmann 170M6612 (3) | |
| P365 | 8 | 200 | — | 428 | 231 | 800 | Bussmann 170M6612 (3) | 20,700 |
| | | — | 180 | 381 | 206 | 800 | Bussmann 170M6612 (3) | |
| P415 | 8 | 240 | — | 487 | 262 | 800 | Bussmann 170M6612 (3) | 20,700 |
| | | — | 200 | 428 | 231 | 800 | Bussmann 170M6612 (3) | |
| P481 | 8 | 280 | — | 564 | 304 | 900 | Bussmann 170M6613 (3) | 20,700 |
| | | — | 240 | 487 | 262 | 900 | Bussmann 170M6613 (3) | |
| P535 | 8 | 300 | — | 627 | 338 | 1000 | Bussmann 170M6614 (3) | 20,700 |
| | | — | 280 | 564 | 304 | 1000 | Bussmann 170M6614 (3) | |
| P600 | 8 | 350 | — | 703 | 379 | 1200 (1) | Bussmann 170M6616 (3) | 20,700 |
| | | — | 300 | 627 | 338 | 1200 (1) | Bussmann 170M6616 (3) | |
| P730 | 9 | 400 | — | 855 | 461 | 1400 (2) | Bussmann 170M6617 (3) | 20,700 |
| | | — | 350 | 703 | 379 | 1400 | Bussmann 170M6617 (3) | |
| H875 No Precharge | 10 | 500 | — | 1025 | 553 | 2 x 800 | Bussmann 170M6612 (3) | 29,900 |
| | | — | 400 | 820 | 443 | 2 x 800 | Bussmann 170M6612 (3) | |

(1) Two 630A Bussmann 170M6608 fuses can also be used.

(2) Two 700A Bussmann 170M6611 fuses can also be used.

(3) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

**Table 8 - PowerFlex 750-Series Drives — Frames 1…7, 540V DC Input Fuses**

| Drive Cat. No. 20F…/20G… | Frame Size | kW Rating | | DC Input Rating | | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | kW | Amps | Catalog No. | | |
| C2P1 | 1 | 0.75 | — | 2.1 | 1.1 | 6 | Bussman JKS-6 (1) | 165 | 41.25 |
| | | — | 0.37 | 1.3 | 0.7 | 4 | Bussman JKS-4 (1) | | |
| C3P5 | 1 | 1.5 | — | 3.7 | 2.0 | 8 | Bussman JKS-8 (1) | 165 | 41.25 |
| | | — | 0.75 | 2.1 | 1.1 | 6 | Bussman JKS-6 (1) | | |
| C5P0 | 1 | 2.2 | — | 5.3 | 2.9 | 10 | Bussman JKS-10 (1) | 280 | 70 |
| | | — | 1.5 | 3.7 | 2.0 | 8 | Bussman JKS-8 (1) | | |
| C8P7 | 1 | 4 | — | 9.3 | 5.0 | 15 | Ferraz Shawmut HSJ15 (2) | 410 | 102.5 |
| | | — | 2.2 | 5.3 | 2.9 | 10 | Ferraz Shawmut HSJ10 (2) | | |
| C011 | 1 | 5.5 | — | 12.6 | 6.8 | 20 | Ferraz Shawmut HSJ20 (2) | 560 | 140 |
| | | — | 4 | 9.3 | 5.0 | 15 | Ferraz Shawmut HSJ15 (2) | | |
| C015 | 1 | 7.5 | — | 17.0 | 9.2 | 25 | Ferraz Shawmut HSJ25 (2) | 680 | 170 |
| | | — | 5.5 | 12.6 | 6.8 | 20 | Ferraz Shawmut HSJ20 (2) | | |
| C015 | 2 | 7.5 | — | 17.0 | 9.2 | 25 | Ferraz Shawmut HSJ25 (2) | 705 | 176 |
| | | — | 5.5 | 12.6 | 6.8 | 20 | Ferraz Shawmut HSJ20 (2) | | |
| C022 | 2 | 11 | — | 24.6 | 13.3 | 40 | Ferraz Shawmut HSJ40 (2) | 1000 | 250 |
| | | — | 7.5 | 17.0 | 9.2 | 25 | Ferraz Shawmut HSJ25 (2) | | |
| C030 | 3 | 15 | — | 33.6 | 18.1 | 50 | Ferraz Shawmut HSJ50 (2) | 1230 | 308 |
| | | — | 11 | 24.6 | 13.3 | 40 | Ferraz Shawmut HSJ40 (2) | | |
| C037 | 3 | 18.5 | — | 41.4 | 22.3 | 70 | Ferraz Shawmut HSJ70 (2) | 1500 | 375 |
| | | — | 15 | 33.6 | 18.1 | 50 | Ferraz Shawmut HSJ50 (2) | | |
| C043 | 3 | 22 | — | 48.1 | 26.0 | 90 | Ferraz Shawmut HSJ90 (2) | 1800 | 450 |
| | | — | 18.5 | 41.4 | 22.3 | 70 | Ferraz Shawmut HSJ70 (2) | | |
| C060 | 4 | 30 | — | 67.1 | 36.2 | 100 | Ferraz Shawmut HSJ100 (2) | 2400 | 600 |
| | | — | 22 | 48.1 | 26.0 | 90 | Ferraz Shawmut HSJ90 (2) | | |
| C072 | 4 | 37 | — | 82.4 | 44.5 | 125 | Ferraz Shawmut HSJ125 (2) | 3000 | 750 |
| | | — | 30 | 67.1 | 36.2 | 100 | Ferraz Shawmut HSJ100 (2) | | |
| C085 | 5 | 45 | — | 97.3 | 52.5 | 150 | Ferraz Shawmut HSJ150 (2) | 3600 | 900 |
| | | — | 37 | 82.4 | 44.5 | 125 | Ferraz Shawmut HSJ125 (2) | | |
| C104 | 5 | 55 | — | 120.2 | 64.9 | 175 | Ferraz Shawmut HSJ175 (2) | 4500 | 1125 |
| | | — | 45 | 97.3 | 52.5 | 150 | Ferraz Shawmut HSJ150 (2) | | |
| C140 | 6 | 75 | — | 160.3 | 86.5 | 250 | Ferraz Shawmut HSJ250 (2) | 4600 | 1150 |
| | | — | 55 | 120.2 | 64.9 | 175 | Ferraz Shawmut HSJ175 (2) | | |
| C170 | 6 | 90 | — | 194.6 | 105.1 | 350 | Ferraz Shawmut HSJ350 (2) | 9200 | 2300 |
| | | — | 75 | 160.3 | 86.5 | 250 | Ferraz Shawmut HSJ250 (2) | | |
| C205 | 6 | 110 | — | 234.7 | 126.7 | 350 | Ferraz Shawmut HSJ350 (2) | 9200 | 2300 |
| | | — | 90 | 194.6 | 105.1 | 350 | Ferraz Shawmut HSJ350 (2) | | |
| C260 | 6 | 132 | — | 297.7 | 160.7 | 400 | Ferraz Shawmut HSJ400 (2) | 9200 | 2300 |
| | | — | 110 | 234.7 | 126.7 | 350 | Ferraz Shawmut HSJ350 (2) | | |
| C302 | 7 | 160 | — | 345.7 | 186.7 | 630 | Bussman 170M6608 (1) | 13,800 | 3450 |
| | | — | 132 | 297.7 | 160.7 | 400 | Ferraz Shawmut HSJ400 (2) | | |
| C367 | 7 | 200 | — | 420.2 | 226.9 | 800 | Bussman 170M6612 (1) | 13,800 | 3450 |
| | | — | 160 | 345.7 | 186.7 | 630 | Bussman 170M6608 (1) | | |
| C456 | 7 | 250 | — | 522.0 | 281.9 | 900 | Bussman 170M6613 (1) | 18,400 | 4600 |
| | | — | 200 | 420.2 | 226.9 | 800 | Bussman 170M6612 (1) | | |

(1) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(2) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 9 - PowerFlex 750-Series Drives — Frames 8…10, 540V DC Input Fuses**

| Drive Cat. No. 20G…[1] | Frame Size | kW Rating | | DC Input Rating | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | kW | | |
| C460 | 8 | 250 | — | 529 | 285.7 | 23,700 | 65,175 |
| | | — | 200 | 443 | 239.2 | | |
| C540 | 8 | 315 | — | 621 | 335.3 | 23,700 | 65,175 |
| | | — | 250 | 525 | 283.5 | | |
| C567 | 8 | 315 | — | 652 | 352.1 | 23,700 | 65,175 |
| | | — | 250 | 543 | 293.2 | | |
| C650 | 8 | 355 | — | 748 | 403.9 | 35,550 | 97,762.5 |
| | | — | 315 | 621 | 335.3 | | |
| C750 | 8 | 400 | — | 863 | 466.0 | 35,550 | 97,762.5 |
| | | — | 315 | 673 | 363.4 | | |
| C770 | 8 | 400 | — | 886 | 478.4 | 35,550 | 97,762.5 |
| | | — | 355 | 739 | 399.1 | | |
| C910 | 9 | 500 | — | 1047 | 565.4 | 47,400 | 41,475 |
| | | — | 400 | 863 | 466.0 | | |
| C1K0 | 9 | 560 | — | 1197 | 646.4 | 47,400 | 41,475 |
| | | — | 500 | 1013 | 547.0 | | |
| C1K1 | 9 | 630 | — | 1254 | 677.2 | 47,400 | 41,475 |
| | | — | 500 | 1047 | 565.4 | | |
| C1K2 | 9 | 710 | — | 1352 | 730.1 | 71,100 | 62,212.5 |
| | | — | 560 | 1197 | 646.4 | | |
| C1K4 | 9 | 800 | — | 1686 | 910.4 | 71,100 | 62,212.5 |
| | | — | 630 | 1254 | 677.2 | | |
| C1K5 | 9 | 850 | — | 1703 | 919.6 | 71,100 | 62,212.5 |
| | | — | 710 | 1352 | 730.1 | | |
| C1K6 | 10 | 900 | — | 1830 | 988.2 | 71,100 | 62,212.5 |
| | | — | 710 | 1525 | 823.5 | | |
| C2K1 | 10 | 1250 | — | 2474 | 1336.0 | 106,650 | 26,662.5 |
| | | — | 1000 | 2071 | 1118.3 | | |

(1) These drives have factory-installed fusing.

**Table 10 - PowerFlex 700H/700S Drives — Frames 9…14, 540V DC Input Fuses**

| Drive Cat. No. 20C… / 20D… | Frame Size | kW Rating | | DC Input Rating | Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | | |
| H261 | 9 | 132 | — | 307 | 500 | Bussman 170M6608 (1) | 6,600 | 0 |
| | | — | 110 | 241 | 500 | Bussman 170M6608 (1) | | |
| H300 | 9 | 160 | — | 353 | 630 | Bussman 170M6610 (1) | 6,600 | 0 |
| | | — | 132 | 288 | 630 | Bussman 170M6610 (1) | | |
| H385 | 10 | 200 | — | 453 | 700 | Bussman 170M6611 (1) | 9,900 | 26,400 |
| | | — | 160 | 353 | 700 | Bussman 170M6611 (1) | | |
| H460 | 10 | 250 | — | 541 | 900 | Bussman 170M6613 (1) | 9,900 | 26,400 |
| | | — | 200 | 453 | 900 | Bussman 170M6613 (1) | | |
| H500 | 10 | 250 | — | 589 | 500 (2 per phase) | Bussman 170M6608 (1) | 9,900 | 26,400 |
| | | — | 250 | 494 | 500 (2 per phase) | Bussman 170M6608 (1) | | |
| H590 | 11 | 315 | — | 695 | 550 (2 per phase) | Bussman 170M6609 (1) | 14,850 | 21,450 |
| | | — | 250 | 612 | 550 (2 per phase) | Bussman 170M6609 (1) | | |
| H650 | 11 | 355 | — | 765 | 630 (2 per phase) | Bussman 170M6610 (1) | 14,850 | 21,450 |
| | | — | 315 | 695 | 630 (2 per phase) | Bussman 170M6610 (1) | | |
| H730 | 11 | 400 | — | 859 | 700 (2 per phase) | Bussman 170M6611 (1) | 14,850 | 21,450 |
| | | — | 355 | 765 | 700 (2 per phase) | Bussman 170M6611 (1) | | |
| H820 | 12 | 450 | — | 965 | 700 (2 per phase) | Bussman 170M6611 (1) | 19,800 | 16,500 |
| | | — | 400 | 859 | 700 (2 per phase) | Bussman 170M6611 (1) | | |
| H920 | 12 | 500 | — | 1083 | 550 (3 per phase) | Bussman 170M6609 (1) | 19,800 | 16,500 |
| | | — | 450 | 965 | 550 (3 per phase) | Bussman 170M6609 (1) | | |
| H1K0 | 12 | 560 | — | 1213 | 630 (3 per phase) | Bussman 170M6610 (1) | 19,800 | 16,500 |
| | | — | 500 | 1083 | 630 (3 per phase) | Bussman 170M6610 (1) | | |
| H1K1 | 13 | 630 | — | 1354 | 2400 | Bussman 170M7107 (1) | 29,700 (2) | 0 |
| | | — | 560 | 1213 | 2400 | Bussman 170M7107 (1) | | |
| H1K3 | 13 | 710 | — | 1530 | 2400 | Bussman 170M7107 (1) | 29,700 (2) | 0 |
| | | — | 630 | 1354 | 2400 | Bussman 170M7107 (1) | | |
| H1K4 | 13 | 800 | — | 1707 | 2400 | Bussman 170M7107 (1) | 29,700 (2) | 0 |
| | | — | 710 | 1413 | 2400 | Bussman 170M7107 (1) | | |
| H1K7 | 14 | 1000 | — | 2084 | — | Bussman 170M8610 (1) | 50,400 (3) | 0 |
| | | — | 900 | 1883 | — | Bussman 170M8610 (1) | | |
| H2K1 | 14 | 1200 | — | 2531 | — | Bussman 170M8610 (1) | 50,400 (3) | 0 |
| | | — | 1100 | 2284 | — | Bussman 170M8610 (1) | | |
| H2K7 | 14 | 1600 | — | 3178 | — | Bussman 170M8610 (1) | 50,400 (3) | 0 |
| | | — | 1300 | 2708 | — | Bussman 170M8610 (1) | | |

(1) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(2) This listed capacitance is for Frame 13 Series B DC fed drives. For Frame 13 Series A DC fed drives, the capacitance is 50,400 µF. For Frame 13 Series B AC fed drives, the capacitance is 36,300 µF.

(3) The listed capacitance is for Frame 14 DC fed drives. For Frame 14 AC fed drives, the capacitance is 72,600 µF.

**Table 11 - PowerFlex 700L Drives — Frames 2, 3A, and 3B, 540V DC Input Fuses**

| Drive Cat. No. 20L… | Frame Size | kW Rating | | DC Input Rating | Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | | |
| C360 | 2 | 200 | 150 | N/A (1) | N/A (1) | N/A (1) | 13,500 | 21,850 |
| C650 | 3A | 370 | 270 | 1250 (2) | 2000 | Bussman 170M6621 (3) (4) | 16,200 | 19,150 (6) |
| C1K2 | 3B | 715 | 525 | 1250 | 2000 | Bussman 170M6621 (3) (4) | 34,400 (5) | 38,301 (6) |

(1) The PowerFlex 700L Frame 2 is not available as a DC input inverter.
(2) Only the Dual Inverter for PowerFlex 700L Frame 3A is available as a DC input inverter.
(3) Two 1000A Bussmann 170M6614 fuses per phase can also be used.
(4) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.
(5) This 34,400 µF is the drive DC bus capacitance for a complete Frame 3B drive. For a Frame 3B common bus inverter, the bus capacitance is 16,200 µF.
(6) This value applies to the precharge of the Frame 3A and 3B complete regenerative drives. There is a field-installed input filter precharge resistor kit (20L-RESPRE-A1) for the Frame 3A and 3B complete drives that can be used to increase the maximum external DC bus capacitance. For details, see publication 20L-IN010.

# 650 Volt DC Input Fuses

**Table 12 - PowerFlex 40P Drives, 650V DC Input Fuses**

| Drive Cat. No. 22D… | HP Rating | DC Input Amps | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|
| | | | Amps | Catalog No. | |
| D1P4 | 0.5 | 1.3 | 3 | Bussmann JKS-3 (1) | 90 |
| D2P3 | 1 | 2.1 | 6 | Bussmann JKS-6 (1) | 135 |
| D4P0 | 2 | 3.6 | 8 | Bussmann JKS-8 (1) | 235 |
| D6P0 | 3 | 5.4 | 15 | Ferraz Shawmut HSJ15 (2) | 280 |
| D010 | 5 | 10.6 | 25 | Ferraz Shawmut HSJ25 (2) | 600 |
| D012 | 7.5 | 12.1 | 25 | Ferraz Shawmut HSJ25 (2) | 705 |
| D017 | 10 | 17.8 | 40 | Ferraz Shawmut HSJ40 (2) | 940 |
| D024 | 15 | 25.4 | 50 | Ferraz Shawmut HSJ50 (2) | 1,120 |

(1) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.
(2) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 13 - PowerFlex 520-Series Drives, 650V DC Input Fuses**

| Drive Cat. No. 25x [1] | HP Rating | | DC Input Amps | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|
| | ND | HD | | Amps | Catalog No. | |
| D1P4 | 0.5 | 0.5 | 1.3 | 3 | Bussmann JKS-3 [2] | 74 |
| D2P3 | 1.0 | 1.0 | 2.1 | 6 | Bussmann JKS-6 [2] | 108 |
| D4P0 | 2.0 | 2.0 | 3.7 | 8 | Bussmann JKS-8 [2] | 192 |
| D6P0 | 3.0 | 3.0 | 5.5 | 15 | Ferraz Shawmut HSJ15 [3] | 282 |
| D010 | 5.0 | 5.0 | 10.6 | 20 | Ferraz Shawmut HSJ20 [3] | 557 |
| D013 | 7.5 | 7.5 | 13.2 | 25 | Ferraz Shawmut HSJ25 [3] | 676 |
| D017 | 10.0 | 10.0 | 17.9 | 40 | Ferraz Shawmut HSJ40 [3] | 816 |
| D024 | 15.0 | 15.0 | 25.6 | 50 | Ferraz Shawmut HSJ50 [3] | 1200 |
| D030 | 20.0 | 15.0 | 32.3 | 50 | Ferraz Shawmut HSJ50 [3] | 1500 |
| D037 | 25.0 | 20.0 | 40.3 | 60 | Ferraz Shawmut HSJ60 [3] | 1399 |
| D043 | 30.0 | 25.0 | 47.4 | 80 | Ferraz Shawmut HSJ80 [3] | 1699 |

(1) The drive catalog number prefix is 25A for PowerFlex 523 drives, and 25B for PowerFlex 525 drives.

(2) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(3) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 14 - PowerFlex 700/700S Drives — Frames 0…6, 650V DC Input Fuses**

| Drive Cat. No. 20B… / 20D… | Frame Size | HP Rating | | DC Input Ratings | Non-Time Delay Fuse (2) | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | |
| D1P1 | 0 | 0.5 | 0.33 | 1.0 | 3 | Bussmann JKS-3 (3) | 110 |
| D2P1 | 0/1 | 1 | 0.75 | 1.9 | 6 | Bussmann JKS-6 (3) | 110 |
| D3P4 | 0/1 | 2 | 1.5 | 3.0 | 6 | Bussmann JKS-6 (3) | 165 |
| D5P0 | 0/1 | 3 | 2 | 4.5 | 10 | Bussmann JKS-10 (3) | 280 |
| D8P0 | 0/1 | 5 | 3 | 8.1 | 15 | Ferraz Shawmut HSJ15 (4) | 330 |
| D011 | 0/1 | 7.5 | 5 | 11.1 | 20 | Ferraz Shawmut HSJ20 (4) | 560 |
| D014 | 1 | 10 | 7.5 | 14.6 | 30 | Ferraz Shawmut HSJ30 (4) | 680 |
| D022 | 1 | 15 | 10 | 23.3 | 40 | Ferraz Shawmut HSJ40 (4) | 1,000 |
| D027 | 2 | 20 | 15 | 28.9 | 50 | Ferraz Shawmut HSJ50 (4) | 1,200 |
| D034 | 2 | 25 | 20 | 36.4 | 60 | Ferraz Shawmut HSJ60 (4) | 1,500 |
| D040 | 3 | 30 | 25 | 42.9 | 80 | Ferraz Shawmut HSJ80 (4) | 1,800 |
| D052 | 3 | 40 | 30 | 55.7 | 90 | Ferraz Shawmut HSJ90 (4) | 2,400 |
| D065 | 3 | 50 | 40 | 69.6 | 100 | Ferraz Shawmut HSJ100 (4) | 3,000 |
| D077 | 4 | 60 | 50 | 84.5 | 150 | Ferraz Shawmut HSJ150 (4) | 3,500 |
| J096 (1) | 5 | 75 | — | 105.3 | 175 | Ferraz Shawmut HSJ175 (4) | 4,500 |
| | | — | 60 | 84.5 | 175 | Ferraz Shawmut HSJ175 (4) | |
| J125 (1) | 5 | 100 | — | 137.1 | 200 | Ferraz Shawmut HSJ200 (4) | 6,000 |
| | | — | 75 | 105.3 | 200 | Ferraz Shawmut HSJ200 (4) | |
| J140 (1) | 5 | 100 | — | 137 | 250 | Ferraz Shawmut HSJ250 (4) | 6,000 |
| | | — | 75 | 105.3 | 250 | Ferraz Shawmut HSJ250 (4) | |
| J156 (1) | 6 | 125 | — | 171 | 300 | Ferraz Shawmut HSJ300 (4) | 6,900 |
| | | — | 100 | 137.1 | 300 | Ferraz Shawmut HSJ300 (4) | |
| J180 (1) | 6 | 150 | — | 198 | 400 | Ferraz Shawmut HSJ400 (4) | 8,400 |
| | | — | 125 | 171.2 | 400 | Ferraz Shawmut HSJ400 (4) | |
| J248 (1) | 6 | 200 | — | 272 | 400 | Ferraz Shawmut HSJ400 (4) | 8,400 |
| | | — | 150 | 198 | 400 | Ferraz Shawmut HSJ400 (4) | |

(1) Also applies to 'R' voltage class. Fuses must be applied in the (+) leg and (-) leg of the DC Common Bus.

(2) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects*: Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses*: Bussmann Type JKS, all sizes; Type 170M, Case Sizes 1, 2 and 3, or Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(3) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(4) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 15 - PowerFlex 700 Drives — Frames 7…10, 650V DC Input Fuses**

| Drive Cat. No. 20B… | Frame Size | HP Rating | | DC Input Rating | | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | kW | Amps | Catalog No. | |
| R292 | 7 | 250 | — | 328 | 212 | 630 | Bussmann 170M6608 (3) | 15,000 |
| | | — | 200 | 296 | 191 | 630 | Bussmann 170M6608 (3) | |
| R325 | 7 | 250 | — | 365 | 236 | 800 | Bussmann 170M6612 (3) | 15,000 |
| | | — | 250 | 365 | 236 | 800 | Bussmann 170M6612 (3) | |
| R365 | 8 | 300 | — | 410 | 265 | 800 | Bussmann 170M6612 (3) | 20,700 |
| | | — | 250 | 365 | 236 | 800 | Bussmann 170M6612 (3) | |
| R415 | 8 | 350 | — | 466 | 302 | 800 | Bussmann 170M6612 (3) | 20,700 |
| | | — | 300 | 410 | 265 | 800 | Bussmann 170M6612 (3) | |
| R481 | 8 | 400 | — | 540 | 350 | 900 | Bussmann 170M6613 (3) | 20,700 |
| | | — | 350 | 466 | 302 | 900 | Bussmann 170M6613 (3) | |
| R535 | 8 | 450 | — | 601 | 389 | 1000 | Bussmann 170M6614 (3) | 20,700 |
| | | — | 400 | 540 | 350 | 1000 | Bussmann 170M6614 (3) | |
| R600 | 8 | 500 | — | 674 | 436 | 1200 (1) | Bussmann 170M6616 (3) | 20,700 |
| | | — | 450 | 601 | 389 | 1200 (1) | Bussmann 170M6616 (3) | |
| R730 | 9 | 600 | — | 820 | 533 | 1400 (2) | Bussmann 170M6617 (3) | 20,700 |
| | | — | 500 | 674 | 436 | 1400 | Bussmann 170M6617 (3) | |
| J875 No precharge | 10 | 700 | — | 983 | 636 | 2 x 800 | Bussmann 170M6612 (3) | 29,900 |
| | | — | 600 | 786 | 509 | 2 x 800 | Bussmann 170M6612 (3) | |

(1) Two 630A Bussmann 170M6608 fuses can also be used.

(2) Two 700A Bussmann 170M6611 fuses can also be used.

(3) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

**Table 16 - PowerFlex 700H/700S Drives — Frames 9…14, 650V DC Input Fuses**

| Drive Cat. No. 20C… / 20D… | Frame Size | HP Rating | | DC Input Rating | Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | | |
| J261 | 9 | 200 | — | 294 | 500 | Bussman 170M6608 (1) | 6,600 | 0 |
| | | — | 150 | 231 | 500 | Bussman 170M6608 (1) | | |
| J300 | 9 | 250 | — | 338 | 630 | Bussman 170M6610 (1) | 6,600 | 0 |
| | | — | 200 | 294 | 630 | Bussman 170M6610 (1) | | |
| J385 | 10 | 300 | — | 434 | 700 | Bussman 170M6611 (1) | 9,900 | 26,400 |
| | | — | 250 | 338 | 700 | Bussman 170M6611 (1) | | |
| J460 | 10 | 350 | — | 519 | 900 | Bussman 170M6613 (1) | 9,900 | 26,400 |
| | | — | 300 | 434 | 900 | Bussman 170M6613 (1) | | |
| J500 | 10 | 450 | — | 564 | 500 (2 per phase) | Bussman 170M6608 (1) | 9,900 | 26,400 |
| | | — | 350 | 474 | 500 (2 per phase) | Bussman 170M6608 (1) | | |
| J590 | 11 | 500 | — | 666 | 550 (2 per phase) | Bussman 170M6609 (1) | 14,850 | 21,450 |
| | | — | 450 | 587 | 550 (2 per phase) | Bussman 170M6609 (1) | | |
| J650 | 11 | 500 | — | 733 | 630 (2 per phase) | Bussman 170M6610 (1) | 14,850 | 21,450 |
| | | — | 500 | 666 | 630 (2 per phase) | Bussman 170M6610 (1) | | |
| J730 | 11 | 600 | — | 824 | 700 (2 per phase) | Bussman 170M6611 (1) | 14,850 | 21,450 |
| | | — | 500 | 733 | 700 (2 per phase) | Bussman 170M6611 (1) | | |
| J820 | 12 | 700 | — | 925 | 700 (2 per phase) | Bussman 170M6611 (1) | 19,800 | 16,500 |
| | | — | 600 | 824 | 700 (2 per phase) | Bussman 170M6611 (1) | | |
| J920 | 12 | 800 | — | 1038 | 550 (3 per phase) | Bussman 170M6609 (1) | 19,800 | 16,500 |
| | | — | 700 | 925 | 550 (3 per phase) | Bussman 170M6609 (1) | | |
| J1K0 | 12 | 900 | — | 1162 | 630 (3 per phase) | Bussman 170M6610 (1) | 19,800 | 16,500 |
| | | — | 800 | 1038 | 630 (3 per phase) | Bussman 170M6610 (1) | | |
| J1K1 | 13 | 1000 | — | 1297 | 2400 | Bussman 170M7107 (1) | 29,700 (2) | 0 |
| | | — | 900 | 1162 | 2400 | Bussman 170M7107 (1) | | |
| J1K3 | 13 | 1200 | — | 1467 | 2400 | Bussman 170M7107 (1) | 29,700 (2) | 0 |
| | | — | 1000 | 1297 | 2400 | Bussman 170M7107 (1) | | |
| J1K4 | 13 | 1250 | — | 1636 | 2400 | Bussman 170M7107 (1) | 29,700 (2) | 0 |
| | | — | 1000 | 1354 | 2400 | Bussman 170M7107 (1) | | |
| J1K7 | 14 | 1500 | — | 1997 | — | Bussman 170M8610 (1) | 50,400 (3) | 0 |
| | | — | 1400 | 1805 | — | Bussman 170M8610 (1) | | |
| J2K1 | 14 | 1900 | — | 2425 | — | Bussman 170M8610 (1) | 50,400 (3) | 0 |
| | | — | 1700 | 2189 | — | Bussman 170M8610 (1) | | |
| J2K7 | 14 | 2300 | — | 3046 | — | Bussman 170M8610 (1) | 50,400 (3) | 0 |
| | | — | 2000 | 2595 | — | Bussman 170M8610 (1) | | |

(1) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(2) This listed capacitance is for Frame 13 Series B DC fed drives. For Frame 13 Series A DC fed drives, the capacitance is 50,400 µF. For Frame 13 Series B AC fed drives, the capacitance is 36,300 µF.

(3) The listed capacitance is for Frame 14 DC fed drives. For Frame 14 AC fed drives, the capacitance is 72,600 µF.

**Table 17 - PowerFlex 700L Drives — Frames 2, 3A, and 3B, 650V DC Input Fuses**

| Drive Cat. No. 20L… | Frame Size | HP Rating | | DC Input Rating | Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | | |
| D360 | 2 | 300 | 235 | N/A (1) | N/A (1) | N/A (1) | 13,500 | 11,049 |
| D650 | 3A | 600 | 440 | 1250 (2) | 2000 | Bussman 170M6621 (3) (4) | 16,200 | 8,349 (6) |
| D1K2 | 3B | 1150 | 845 | 1250 | 2000 | Bussman 170M6621 (3) (4) | 34,400 (5) | 16,698 (6) |

(1) The PowerFlex 700L Frame 2 is not available as a DC input inverter.

(2) Only the Dual Inverter for PowerFlex 700L Frame 3A is available as a DC input inverter.

(3) Two 1000A Bussmann 170M6614 fuses per phase can also be used.

(4) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(5) This 34,400 µF is the drive DC bus capacitance for a complete Frame 3B drive. The Frame 3B DC input inverter bus capacitance is 16,200 µF.

(6) This value applies to the precharge of the Frame 3A and 3B complete regenerative drives. There is a field-installed input filter precharge resistor kit (20L-RESPRE-A1) for the Frame 3A and 3B complete drives that can be used to increase the maximum external DC bus capacitance. For details, see publication 20L-IN010.

**Table 18 - PowerFlex 750-Series Drives — Frames 1…7, 650V DC Input Fuses**

| Drive Cat. No. 20F…/20G… | Frame Size | HP Rating | | DC Input Rating | | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | kW | Amps | Catalog No. | | |
| D2P1 | 1 | 1 | — | 1.9 | 1.2 | 6 | Bussman JKS-6 (1) | 165 | 41.25 |
| | | — | 0.5 | 1.1 | 0.72 | 4 | Bussman JKS-4 (1) | | |
| D3P4 | 1 | 2 | — | 3.0 | 2.0 | 6 | Bussman JKS-6 (1) | 165 | 41.25 |
| | | — | 1 | 1.9 | 1.2 | 6 | Bussman JKS-6 (1) | | |
| D5P0 | 1 | 3 | — | 4.5 | 2.9 | 10 | Bussman JKS-10 (1) | 280 | 70 |
| | | — | 2 | 3.0 | 2.0 | 6 | Bussman JKS-6 (1) | | |
| D8P0 | 1 | 5 | — | 8.1 | 5.3 | 15 | Ferraz Shawmut HSJ15 (2) | 410 | 102.5 |
| | | — | 3 | 4.5 | 2.9 | 10 | Bussman JKS-10 (1) | | |
| D011 | 1 | 7.5 | — | 11.1 | 7.2 | 20 | Ferraz Shawmut HSJ20 (2) | 560 | 140 |
| | | — | 5 | 8.1 | 5.3 | 15 | Ferraz Shawmut HSJ15 (2) | | |
| D014 | 1 | 10 | — | 14.7 | 9.6 | 30 | Ferraz Shawmut HSJ30 (2) | 680 | 170 |
| | | — | 7.5 | 11.1 | 7.2 | 20 | Ferraz Shawmut HSJ20 (2) | | |
| D014 | 2 | 10 | — | 14.7 | 9.5 | 30 | Ferraz Shawmut HSJ30 (2) | 705 | 176 |
| | | — | 7.5 | 11.1 | 7.2 | 20 | Ferraz Shawmut HSJ20 (2) | | |
| D022 | 2 | 15 | — | 23.3 | 15.1 | 40 | Ferraz Shawmut HSJ40 (2) | 1000 | 250 |
| | | — | 10 | 14.7 | 9.5 | 30 | Ferraz Shawmut HSJ30 (2) | | |
| D027 | 3 | 20 | — | 28.9 | 18.8 | 50 | Ferraz Shawmut HSJ50 (2) | 1230 | 308 |
| | | — | 15 | 23.3 | 15.1 | 40 | Ferraz Shawmut HSJ40 (2) | | |
| D034 | 3 | 25 | — | 36.4 | 23.6 | 60 | Ferraz Shawmut HSJ60 (2) | 1500 | 375 |
| | | — | 20 | 28.9 | 18.8 | 50 | Ferraz Shawmut HSJ50 (2) | | |
| D040 | 3 | 30 | — | 42.9 | 27.8 | 80 | Ferraz Shawmut HSJ80 (2) | 1800 | 450 |
| | | — | 25 | 36.4 | 23.6 | 60 | Ferraz Shawmut HSJ60 (2) | | |
| D052 | 4 | 40 | — | 55.7 | 36.1 | 90 | Ferraz Shawmut HSJ90 (2) | 2400 | 600 |
| | | — | 30 | 42.9 | 27.8 | 80 | Ferraz Shawmut HSJ80 (2) | | |
| D065 | 4 | 50 | — | 69.7 | 45.1 | 100 | Ferraz Shawmut HSJ100 (2) | 3000 | 750 |
| | | — | 40 | 55.7 | 36.1 | 90 | Ferraz Shawmut HSJ90 (2) | | |
| D077 | 5 | 60 | — | 84.5 | 54.7 | 150 | Ferraz Shawmut HSJ150 (2) | 3600 | 900 |
| | | — | 50 | 69.7 | 45.1 | 100 | Ferraz Shawmut HSJ100 (2) | | |
| D096 | 5 | 75 | — | 105.3 | 68.3 | 175 | Ferraz Shawmut HSJ175 (2) | 4500 | 1125 |
| | | — | 60 | 84.5 | 54.7 | 150 | Ferraz Shawmut HSJ150 (2) | | |
| D125 | 6 | 100 | — | 137.1 | 88.9 | 200 | Ferraz Shawmut HSJ200 (2) | 4600 | 1150 |
| | | — | 75 | 105.3 | 68.3 | 175 | Ferraz Shawmut HSJ175 (2) | | |
| D156 | 6 | 125 | — | 171.2 | 110.9 | 300 | Ferraz Shawmut HSJ300 (2) | 9200 | 2300 |
| | | — | 100 | 137.1 | 88.9 | 200 | Ferraz Shawmut HSJ200 (2) | | |
| D186 | 6 | 150 | — | 204.1 | 132.2 | 400 | Ferraz Shawmut HSJ400 (2) | 9200 | 2300 |
| | | — | 125 | 171.2 | 110.9 | 300 | Ferraz Shawmut HSJ300 (2) | | |
| D248 | 6 | 200 | — | 272.1 | 176.3 | 400 | Ferraz Shawmut HSJ400 (2) | 9200 | 2300 |
| | | — | 150 | 204.1 | 132.2 | 400 | Ferraz Shawmut HSJ400 (2) | | |
| D302 | 7 | 250 | — | 331.3 | 214.7 | 630 | Bussman 170M6608 (1) | 13,800 | 3450 |
| | | — | 200 | 272.1 | 176.3 | 400 | Ferraz Shawmut HSJ400 (2) | | |
| D361 | 7 | 300 | — | 396.1 | 256.6 | 800 | Bussman 170M6612 (1) | 13,800 | 3450 |
| | | — | 250 | 331.3 | 214.7 | 630 | Bussman 170M6608 (1) | | |
| D415 | 7 | 350 | — | 455.3 | 295.0 | 900 | Bussman 170M6613 (1) | 18,400 | 4600 |
| | | — | 300 | 396.1 | 256.6 | 800 | Bussman 170M6612 (1) | | |

(1) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(2) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 19 - PowerFlex 750-Series Drives — Frames 8…10, 650V DC Input Fuses**

| Drive Cat. No. 20G…[1] | Frame Size | HP Rating | | DC Input Rating | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | kW | | |
| D430 | 8 | 350 | — | 473 | 307.5 | 23,700 | 65,175 |
| | | — | 300 | 407 | 264.6 | | |
| D485 | 8 | 400 | — | 533 | 346.5 | 23,700 | 65,175 |
| | | — | 350 | 455 | 295.8 | | |
| D545 | 8 | 450 | — | 599 | 389.4 | 23,700 | 65,175 |
| | | — | 350 | 499 | 324.4 | | |
| D617 | 8 | 500 | — | 678 | 440.7 | 35,550 | 97,762.5 |
| | | — | 400 | 533 | 346.5 | | |
| D710 | 8 | 600 | — | 781 | 507.7 | 35,550 | 97,762.5 |
| | | — | 450 | 599 | 389.4 | | |
| D740 | 8 | 650 | — | 814 | 529.1 | 35,550 | 97,762.5 |
| | | — | 500 | 678 | 440.7 | | |
| D800 | 9 | 700 | — | 880 | 572.0 | 47,400 | 41,475 |
| | | — | 600 | 781 | 507.7 | | |
| D960 | 9 | 800 | — | 1055 | 685.8 | 47,400 | 41,475 |
| | | — | 700 | 874 | 568.1 | | |
| D1K0 | 9 | 900 | — | 1149 | 746.9 | 47,400 | 41,475 |
| | | — | 750 | 880 | 572.0 | | |
| D1K2 | 9 | 1000 | — | 1248 | 811.2 | 71,100 | 17,775 |
| | | — | 800 | 1055 | 685.8 | | |
| D1K3 | 9 | 1100 | — | 1501 | 975.7 | 71,100 | 17,775 |
| | | — | 900 | 1149 | 746.9 | | |
| D1K4 | 9 | 1250 | — | 1561 | 1014.7 | 71,100 | 17,775 |
| | | — | 1000 | 1248 | 811.2 | | |
| D1K5 | 10 | 1350 | — | 1677 | 1090.1 | 71,100 | 17,775 |
| | | — | 1100 | 1396 | 907.4 | | |
| D2K0 | 10 | 1750 | — | 2276 | 1479.4 | 106,650 | 26,662.5 |
| | | — | 1650 | 1902 | 1236.3 | | |

(1) These drives have factory-installed fusing.

# 810 Volt DC Input Fuses

**Table 20 - PowerFlex 40P Drives, 810V DC Input Fuses**

| Drive Cat. No. 22D… | HP Rating | DC Input Amps | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|
| | | | Amps | Catalog No. | |
| E1P7 | 1 | 1.5 | 6 | Bussmann JKS-6 (1) | 75 |
| E3P0 | 2 | 2.7 | 6 | Bussmann JKS-6 (1) | 110 |
| E4P2 | 3 | 3.8 | 10 | Bussmann JKS-10 (1) | 135 |
| E6P6 | 5 | 6.7 | 15 | Ferraz Shawmut HSJ15 (2) | 280 |
| E9P9 | 7.5 | 10.0 | 20 | Ferraz Shawmut HSJ20 (2) | 330 |
| E012 | 10 | 12.8 | 25 | Ferraz Shawmut HSJ25 (2) | 440 |
| E019 | 15 | 20.1 | 40 | Ferraz Shawmut HSJ40 (2) | 440 |

(1) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(2) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 21 - PowerFlex 520-Series Drives, 810V DC Input Fuses**

| Drive Cat. No. 25x (1) | HP Rating | | DC Input Amps | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|
| | ND | HD | | Amps | Catalog No. | |
| E0P9 | 0.4 | 0.4 | 0.8 | 3 | Bussmann JKS-3 (2) | 50 |
| E1P7 | 0.75 | 0.75 | 1.6 | 6 | Bussmann JKS-6 (2) | 75 |
| E3P0 | 1.5 | 1.5 | 2.8 | 6 | Bussmann JKS-6 (2) | 111 |
| E4P2 | 2.2 | 2.2 | 3.9 | 8 | Bussmann JKS-8 (2) | 134 |
| E6P6 | 4.0 | 4.0 | 6.8 | 15 | Ferraz Shawmut HSJ15 (3) | 218 |
| E9P9 | 5.5 | 5.5 | 10.1 | 20 | Ferraz Shawmut HSJ20 (3) | 327 |
| E012 | 7.5 | 7.5 | 12.6 | 25 | Ferraz Shawmut HSJ25 (3) | 396 |
| E019 | 11.0 | 11.0 | 20.1 | 40 | Ferraz Shawmut HSJ40 (3) | 589 |
| E022 | 15.0 | 11.0 | 23.6 | 40 | Ferraz Shawmut HSJ40 (3) | 836 |
| E027 | 18.5 | 15.0 | 29.3 | 50 | Ferraz Shawmut HSJ50 (3) | 783 |
| E032 | 22.0 | 18.5 | 35.1 | 60 | Ferraz Shawmut HSJ60 (3) | 960 |

(1) The drive catalog number prefix is 25A for PowerFlex 523 drives, and 25B for PowerFlex 525 drives.

(2) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(3) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 22 - PowerFlex 700/700S Drives — Frames 1…6, 810V DC Input Fuses**

| Drive Cat. No. 20B… / 20D… | Frame Size | HP Rating | | DC Input Rating | Non-Time Delay Fuse (1) | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | |
| E1P7 | 0/1 | 1 | 0.75 | 1.5 | 3 | Bussmann JKS-3 (2) | 195 |
| E2P7 | 0/1 | 2 | 1.5 | 2.4 | 6 | Bussmann JKS-6 (2) | 195 |
| E3P9 | 0/1 | 3 | 2 | 3.5 | 6 | Bussmann JKS-6 (2) | 195 |
| E6P1 | 0/1 | 5 | 3 | 6.2 | 10 | Bussmann JKS-10 (2) | 390 |
| E9P0 | 0/1 | 7.5 | 5 | 9.1 | 15 | Ferraz Shawmut HSJ15 (3) | 390 |
| E011 | 1 | 10 | 7.5 | 11.5 | 20 | Ferraz Shawmut HSJ20 (3) | 560 |
| E017 | 1 | 15 | 10 | 18 | 30 | Ferraz Shawmut HSJ30 (3) | 560 |
| E022 | 2 | 20 | 15 | 23.6 | 40 | Ferraz Shawmut HSJ40 (3) | 1,000 |
| E027 | 2 | 25 | 20 | 29 | 50 | Ferraz Shawmut HSJ50 (3) | 1,200 |
| E032 | 3 | 30 | 25 | 34.3 | 60 | Ferraz Shawmut HSJ60 (3) | 1,400 |
| E041 | 3 | 40 | 30 | 43.9 | 70 | Ferraz Shawmut HSJ70 (3) | 1,800 |
| E052 | 3 | 50 | 40 | 55.7 | 90 | Ferraz Shawmut HSJ90 (3) | 2,400 |
| E062 | 4 | 60 | 50 | 68.0 | 125 | Ferraz Shawmut HSJ125 (3) | 2,400 |
| T099 | 5 | 100 | — | 108.6 | 150 | Ferraz Shawmut HSJ150 (3) | 3,500 |
| | | — | 75 | 84.5 | 150 | Ferraz Shawmut HSJ150 (3) | |
| T144 | 6 | 150 | — | 158 | 200 | Ferraz Shawmut HSJ200 (3) | 5,000 |
| | | — | 125 | 137.1 | 200 | Ferraz Shawmut HSJ200 (3) | |

(1) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects*: Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses*: Bussmann Type JKS, all sizes; Type 170M, Case Sizes 1, 2 and 3, or Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(2) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(3) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 23 - PowerFlex 700H/700S Drives — Frames 9…14, 810V DC Input Fuses**

| Drive Cat. No. 20C… / 20D… | Frame Size | HP Rating | | DC Input Rating | Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | | |
| K170 | 9 | 150 | — | 192 | 400 | Bussman 170M5608 (2) | 3,600 | 0 |
| | | — | 150 | 162 | 400 | Bussman 170M5608 (2) | | |
| K208 | 9 | 200 | — | 235 | 450 | Bussman 170M5609 (2) | 3,600 | 0 |
| | | — | 150 | 192 | 450 | Bussman 170M5609 (2) | | |
| K261 | 10 | 250 | — | 294 | 450 | Bussman 170M5609 (2) | 7,467 | 19,333 |
| | | — | 200 | 235 | 450 | Bussman 170M5609 (2) | | |
| K325 | 10 | 350 | — | 367 | 550 | Bussman 170M6609 (2) | 7,467 | 19,333 |
| | | — | 250 | 294 | 550 | Bussman 170M6609 (2) | | |
| K385 | 10 | 400 | — | 434 | 700 | Bussman 170M6611 (2) | 7,467 | 19,333 |
| | | — | 350 | 367 | 700 | Bussman 170M6611 (2) | | |
| K416 | 10 | 450 | — | 469 | 800 | Bussman 170M6612 (2) | 7,467 | 19,333 |
| | | — | 350 | 367 | 800 | Bussman 170M6612 (2) | | |
| K460 | 11 | 500 | — | 519 | 450 (2 per phase) | Bussman 170M5609 (2) | 11,200 | 15,600 |
| | | — | 400 | 434 | 450 (2 per phase) | Bussman 170M5609 (2) | | |
| K502 | 11 | 500 | — | 566 | 500 (2 per phase) | Bussman 170M6608 (2) | 11,200 | 15,600 |
| | | — | 500 | 519 | 500 (2 per phase) | Bussman 170M6608 (2) | | |
| K590 | 11 | 600 | — | 666 | 500 (2 per phase) | Bussman 170M6608 (2) | 11,200 | 15,600 |
| | | — | 500 | 566 | 500 (2 per phase) | Bussman 170M6608 (2) | | |
| K650 | 12 | 700 | — | 733 | 500 (2 per phase) | Bussman 170M6608 (2) | 14,933 | 11,867 |
| | | — | 650 | 666 | 500 (2 per phase) | Bussman 170M6608 (2) | | |
| K750 | 12 | 800 | — | 846 | 630 (2 per phase) | Bussman 170M6610 (2) | 14,933 | 11,867 |
| | | — | 700 | 733 | 630 (2 per phase) | Bussman 170M6610 (2) | | |
| K820 (1) | 12 | 900 | — | 925 | 630 (2 per phase) | Bussman 170M6610 (2) | 14,933 | 11,867 |
| | | — | 700 | 733 | 630 (2 per phase) | Bussman 170M6610 (2) | | |
| K920 | 13 | 1000 | — | 1038 | 2400 | Bussman 170M7107 (2) | 22,400 (3) | 0 |
| | | — | 900 | 925 | 2400 | Bussman 170M7107 (2) | | |
| K1K0 | 13 | 1100 | — | 1162 | 2400 | Bussman 170M7107 (2) | 22,400 (3) | 0 |
| | | — | 1000 | 1038 | 2400 | Bussman 170M7107 (2) | | |
| K1K1 | 13 | 1300 | — | 1331 | 2400 | Bussman 170M7107 (2) | 22,400 (3) | 0 |
| | | — | 1100 | 1162 | 2400 | Bussman 170M7107 (2) | | |
| K1K5 | 14 | 1600 | — | 1692 | — | Bussman 170M8610 (2) | 44,800 (4) | 0 |
| | | — | 1400 | 1467 | — | Bussman 170M8610 (2) | | |
| K1K9 | 14 | 2000 | — | 2143 | — | Bussman 170M8610 (2) | 44,800 (4) | 0 |
| | | — | 1600 | 1692 | — | Bussman 170M8610 (2) | | |
| K2K2 | 14 | 2400 | — | 2538 | — | Bussman 170M8610 (2) | 44,800 (4) | 0 |
| | | — | 2000 | 2143 | — | Bussman 170M8610 (2) | | |

(1) 20DK820 drives (ND) are only capable of producing 95% of starting torque under 10 Hz.

(2) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(3) This listed capacitance is for Frame 13 DC fed drives. For Frame 13 AC fed drives, the capacitance is 26,800 µF.

(4) The listed capacitance is for Frame 14 DC fed drives. For Frame 14 AC fed drives, the capacitance is 53,600 µF.

**Table 24 - PowerFlex 700L Drives — Frames 3A and 3B, 810V DC Input Fuses**

| Drive Cat. No. 20L… | Frame Size | HP Rating | | DC Input Rating | Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | | |
| E425 | 3A | 465 | 345 | 850 (1) | 1400 | Bussman 170M6701 (2) (3) | 10,800 | 4,911 (6) |
| E800 | 3B | 870 | 640 | 800 | 1250 | Bussman 170M6700 (3) (4) | 21,600 (5) | 9,823 (6) |
| E1K1 | 3B | 1275 | 935 | 1175 | 900 (2 per phase) | Bussman 170M6697 (3) | 21,600 (5) | 9,823 (6) |

(1) Only the Dual Inverter for PowerFlex 700L Frame 3A is available as a DC input inverter.

(2) Two 700A Bussmann 170M6695 fuses per phase can also be used.

(3) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(4) Two 630A Bussmann 170M6694 fuses per phase can also be used.

(5) This 21,600 µF is the drive DC bus capacitance for a complete Frame 3B drive. The Frame 3B DC input inverter bus capacitance is 10,800 µF.

(6) This value applies to the precharge of the Frame 3A and 3B complete regenerative drives. There is a field-installed input filter precharge resistor kit (20L-RESPRE-A1) for the Frame 3A and 3B complete drives that can be used to increase the maximum external DC bus capacitance. For details, see publication 20L-IN010.

### Table 25 - PowerFlex 750-Series Drives — Frames 3…7, 810V DC Input Fuses

| Drive Cat. No. 20F…/20G… | Frame Size | HP Rating | | DC Input Rating | | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | kW | Amps | Catalog No. | | |
| E1P7 | 3 | 1 | — | 1.9 | 1.5 | 4 | Bussman JKS-4 (1) | 1500 | 375 |
| | | — | 0.5 | 1.0 | 0.8 | 2 | Bussman JKS-2 (1) | | |
| E2P7 | 3 | 2 | — | 3.0 | 2.4 | 5 | Bussman JKS-5 (1) | 1500 | 375 |
| | | — | 1 | 1.9 | 1.5 | 4 | Bussman JKS-4 (1) | | |
| E3P9 | 3 | 3 | — | 4.3 | 3.5 | 8 | Bussman JKS-8 (1) | 1500 | 375 |
| | | — | 2 | 3.0 | 2.4 | 5 | Bussman JKS-5 (1) | | |
| E6P1 | 3 | 5 | — | 6.7 | 5.4 | 10 | Bussman JKS-10 (1) | 1500 | 375 |
| | | — | 3 | 4.3 | 3.5 | 8 | Bussman JKS-8 (1) | | |
| E9P0 | 3 | 7.5 | — | 9.9 | 8.0 | 15 | Ferraz Shawmut HSJ15 (2) | 1500 | 375 |
| | | — | 5 | 6.7 | 5.4 | 10 | Ferraz Shawmut HSJ10 (2) | | |
| E011 | 3 | 10 | — | 12.0 | 9.7 | 20 | Ferraz Shawmut HSJ20 (2) | 1500 | 375 |
| | | — | 7.5 | 9.9 | 8.0 | 15 | Ferraz Shawmut HSJ15 (2) | | |
| E012 | 6 | 10 | — | 13.1 | 10.6 | 20 | Ferraz Shawmut HSJ20 (2) | 5200 | 1300 |
| | | — | 7.5 | 10.0 | 8.1 | 15 | Ferraz Shawmut HSJ15 (2) | | |
| E017 | 3 | 15 | — | 18.6 | 15.1 | 30 | Ferraz Shawmut HSJ30 (2) | 1500 | 375 |
| | | — | 10 | 12.0 | 9.7 | 20 | Ferraz Shawmut HSJ20 (2) | | |
| E018 | 6 | 15 | — | 19.7 | 16.0 | 30 | Ferraz Shawmut HSJ30 (2) | 5200 | 1300 |
| | | — | 10 | 13.1 | 10.6 | 20 | Ferraz Shawmut HSJ20 (2) | | |
| E022 | 3 | 20 | — | 24.1 | 19.5 | 40 | Ferraz Shawmut HSJ40 (2) | 1500 | 375 |
| | | — | 15 | 18.6 | 15.1 | 30 | Ferraz Shawmut HSJ30 (2) | | |
| E023 | 6 | 20 | — | 25.2 | 20.4 | 40 | Ferraz Shawmut HSJ40 (2) | 5200 | 1300 |
| | | — | 15 | 19.7 | 16.0 | 30 | Ferraz Shawmut HSJ30 (2) | | |
| E024 | 6 | 20 | — | 26.3 | 21.3 | 40 | Ferraz Shawmut HSJ40 (2) | 5200 | 1300 |
| | | — | 20 | 24.1 | 19.5 | 40 | Ferraz Shawmut HSJ40 (2) | | |
| E027 | 4 | 25 | — | 29.6 | 24.0 | 50 | Ferraz Shawmut HSJ50 (2) | 1800 | 450 |
| | | — | 20 | 24.1 | 19.5 | 40 | Ferraz Shawmut HSJ40 (2) | | |
| E028 | 6 | 25 | — | 30.7 | 24.9 | 50 | Ferraz Shawmut HSJ50 (2) | 5200 | 1300 |
| | | — | 20 | 25.2 | 20.4 | 40 | Ferraz Shawmut HSJ40 (2) | | |
| E032 | 4 | 30 | — | 35.0 | 28.4 | 60 | Ferraz Shawmut HSJ60 (2) | 1800 | 450 |
| | | — | 25 | 29.6 | 24.0 | 50 | Ferraz Shawmut HSJ50 (2) | | |
| E033 | 6 | 30 | — | 36.1 | 29.2 | 60 | Ferraz Shawmut HSJ60 (2) | 5200 | 1300 |
| | | — | 25 | 30.7 | 24.9 | 50 | Ferraz Shawmut HSJ50 (2) | | |
| E041 | 5 | 40 | — | 44.9 | 36.4 | 70 | Ferraz Shawmut HSJ70 (2) | 3600 | 900 |
| | | — | 30 | 35.0 | 28.4 | 60 | Ferraz Shawmut HSJ60 (2) | | |
| E042 | 6 | 40 | — | 46.0 | 37.3 | 70 | Ferraz Shawmut HSJ70 (2) | 5200 | 1300 |
| | | — | 30 | 36.1 | 29.2 | 60 | Ferraz Shawmut HSJ60 (2) | | |
| E052 | 5 | 50 | — | 56.9 | 46.1 | 90 | Ferraz Shawmut HSJ90 (2) | 3600 | 900 |
| | | — | 40 | 44.9 | 36.4 | 70 | Ferraz Shawmut HSJ70 (2) | | |
| E053 | 6 | 50 | — | 58.0 | 47.0 | 90 | Ferraz Shawmut HSJ90 (2) | 2600 | 650 |
| | | — | 40 | 46.0 | 37.3 | 70 | Ferraz Shawmut HSJ70 (2) | | |
| E063 | 6 | 60 | — | 69.0 | 55.9 | 110 | Ferraz Shawmut HSJ110 (2) | 5200 | 1300 |
| | | — | 50 | 58.0 | 47.0 | 90 | Ferraz Shawmut HSJ90 (2) | | |
| E077 | 6 | 75 | — | 84.3 | 68.3 | 150 | Ferraz Shawmut HSJ150 (2) | 5200 | 1300 |
| | | — | 60 | 69.0 | 55.9 | 110 | Ferraz Shawmut HSJ110 (2) | | |
| E099 | 6 | 100 | — | 108.4 | 87.8 | 175 | Ferraz Shawmut HSJ175 (2) | 5200 | 1300 |
| | | — | 75 | 84.3 | 68.3 | 150 | Ferraz Shawmut HSJ150 (2) | | |
| E125 | 6 | 125 | — | 136.8 | 110.8 | 225 | Ferraz Shawmut HSJ225 (2) | 5200 | 1300 |
| | | — | 100 | 108.4 | 87.8 | 175 | Ferraz Shawmut HSJ175 (2) | | |
| E144 | 6 | 150 | — | 157.6 | 127.7 | 250 | Ferraz Shawmut HSJ250 (2) | 5200 | 1300 |
| | | — | 125 | 136.8 | 110.8 | 225 | Ferraz Shawmut HSJ225 (2) | | |
| E192 | 7 | 200 | — | 210.2 | 170.3 | 350 | Ferraz Shawmut HSJ350 (2) | 11,700 | 2925 |
| | | — | 150 | 157.6 | 127.7 | 250 | Ferraz Shawmut HSJ250 (2) | | |
| E242 | 7 | 250 | — | 264.9 | 214.6 | 400 | Ferraz Shawmut HSJ400 (2) | 11,700 | 2925 |
| | | — | 200 | 210.2 | 170.3 | 350 | Ferraz Shawmut HSJ350 (2) | | |
| E289 | 7 | 300 | — | 316.4 | 256.3 | 500 | Ferraz Shawmut HSJ500 (2) | 11,700 | 2925 |
| | | — | 250 | 264.9 | 214.6 | 400 | Ferraz Shawmut HSJ400 (2) | | |

(1) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(2) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 26 - PowerFlex 750-Series Drives — Frames 8…10, 810V DC Input Fuses**

| Drive Cat. No. 20G…[1] | Frame Size | HP Rating | | DC Input Rating | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | kW | | |
| E295 | 8 | 300 | — | 325 | 263.3 | 16,800 | 46,200 |
| | | — | 250 | 300 | 243.0 | | |
| E355 | 8 | 350 | — | 391 | 316.7 | 16,800 | 46,200 |
| | | — | 300 | 325 | 263.3 | | |
| E395 | 8 | 400 | — | 436 | 353.2 | 16,800 | 46,200 |
| | | — | 350 | 363 | 294.0 | | |
| E435 | 8 | 450 | — | 480 | 388.8 | 25,200 | 69,300 |
| | | — | 350 | 391 | 316.7 | | |
| E460 | 8 | 500 | — | 507 | 410.7 | 25,200 | 69,300 |
| | | — | 400 | 436 | 353.2 | | |
| E510 | 8 | 500 | — | 562 | 455.2 | 25,200 | 69,300 |
| | | — | 450 | 469 | 379.9 | | |
| E595 | 9 | 600 | — | 656 | 531.4 | 33,600 | 29,400 |
| | | — | 500 | 562 | 455.2 | | |
| E630 | 9 | 700 | — | 695 | 563.0 | 33,600 | 29,400 |
| | | — | 600 | 656 | 531.4 | | |
| E760 | 9 | 800 | — | 838 | 678.8 | 33,600 | 29,400 |
| | | — | 700 | 695 | 563.0 | | |
| E825 | 9 | 900 | — | 910 | 737.1 | 50,400 | 44,100 |
| | | — | 750 | 772 | 625.3 | | |
| E900 | 9 | 950 | — | 993 | 804.3 | 50,400 | 44,100 |
| | | — | 800 | 838 | 678.8 | | |
| E980 | 9 | 1000 | — | 1081 | 875.6 | 50,400 | 44,100 |
| | | — | 900 | 899 | 728.2 | | |
| E1K1 | 10 | 1100 | — | 1224 | 991.4 | 50,400 | 12,600 |
| | | — | 1000 | 1015 | 822.2 | | |
| E1K4 | 10 | 1400 | — | 1577 | 1277.4 | 75,600 | 18,900 |
| | | — | 1250 | 1312 | 1062.7 | | |

(1) These drives have factory-installed fusing.

## 932 Volt DC Input Fuses

**Table 27 - PowerFlex 700/700S Drives — Frames 5 and 6, 932V DC Input Fuses**

| Drive Cat. No. 20B… / 20D… | Frame Size | kW Rating | | DC Input Rating | Non-Time Delay Fuse[1] | | Drive DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | |
| W098 | 5 | 90 | — | 92.3 | 160 | Ferraz Shawmut HSJ160 [2] | 3,500 |
| | | — | 75 | 92.3 | 160 | Ferraz Shawmut HSJ160 [2] | |
| W142 | 6 | 132 | — | 162.2 | 250 | Ferraz Shawmut HSJ250 [2] | 5,000 |
| | | — | 110 | 134.9 | 250 | Ferraz Shawmut HSJ250 [2] | |

(1) The power source to Common Bus inverters must be derived from AC voltages 600V or less, as defined in NFPA70; Art 430-18 (NEC). Battery supplies or MG sets are not included. The following devices were validated to break current of the derived power DC Bus: *Disconnects*: Allen-Bradley Bulletin No. 1494, 30 to 400 A; Bulletin No. 194, 30 to 400 A, or ABB: OESA, 600 & 800 A; OESL, all sizes. *Fuses*: Bussmann Type JKS, all sizes; Type 170M, Case Sizes 1, 2 and 3, or Ferraz Shawmut Type HSJ, all sizes. For any other devices, please contact the factory.

(2) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 28 - PowerFlex 700H/700S Drives — Frames 9…14, 932V DC Input Fuses**

| Drive Cat. No. 20C… / 20D… | Frame Size | kW Rating | | DC Input Rating | Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | | |
| M170 | 9 | 160 | — | 200 | 315 | Bussman 170M3746 (2) | 3,600 | 0 |
| | | — | 132 | 170 | 315 | Bussman 170M3746 (2) | | |
| M208 | 9 | 200 | — | 245 | 400 | Bussman 170M5742 (2) | 3,600 | 0 |
| | | — | 160 | 200 | 400 | Bussman 170M5742 (2) | | |
| M261 | 10 | 250 | — | 307 | 500 | Bussman 170M5744 (2) | 7,467 | 19,333 |
| | | — | 200 | 245 | 500 | Bussman 170M5744 (2) | | |
| M325 | 10 | 315 | — | 383 | 630 | Bussman 170M5746 (2) | 7,467 | 19,333 |
| | | — | 250 | 307 | 630 | Bussman 170M5746 (2) | | |
| M385 | 10 | 355 | — | 453 | 700 | Bussman 170M6745 (2) | 7,467 | 19,333 |
| | | — | 315 | 383 | 700 | Bussman 170M6745 (2) | | |
| M416 | 10 | 400 | — | 490 | 700 | Bussman 170M6745 (2) | 7,467 | 19,333 |
| | | — | 315 | 383 | 700 | Bussman 170M6745 (2) | | |
| M460 | 11 | 450 | — | 542 | 450 (2 per phase) | Bussman 170M5743 (2) | 11,200 | 15,600 |
| | | — | 355 | 453 | 450 (2 per phase) | Bussman 170M5743 (2) | | |
| M502 | 11 | 500 | — | 591 | 500 (2 per phase) | Bussman 170M5744 (2) | 11,200 | 15,600 |
| | | — | 400 | 542 | 500 (2 per phase) | Bussman 170M5744 (2) | | |
| M590 | 11 | 560 | — | 695 | 500 (2 per phase) | Bussman 170M5744 (2) | 11,200 | 15,600 |
| | | — | 500 | 591 | 500 (2 per phase) | Bussman 170M5744 (2) | | |
| M650 | 12 | 630 | — | 765 | 550 (2 per phase) | Bussman 170M5745 (2) | 14,933 | 11,867 |
| | | — | 560 | 695 | 550 (2 per phase) | Bussman 170M5745 (2) | | |
| M750 | 12 | 710 | — | 883 | 630 (2 per phase) | Bussman 170M5746 (2) | 14,933 | 11,867 |
| | | — | 630 | 765 | 630 (2 per phase) | Bussman 170M5746 (2) | | |
| M820 (1) | 12 | 800 | — | 965 | 630 (2 per phase) | Bussman 170M5746 (2) | 14,933 | 11,867 |
| | | — | 630 | 765 | 630 (2 per phase) | Bussman 170M5746 (2) | | |
| M920 | 13 | 900 | — | 1038 | 2400 | Bussman 170M7107 (2) | 22,400 (3) | 0 |
| | | — | 800 | 925 | 2400 | Bussman 170M7107 (2) | | |
| M1K0 | 13 | 1000 | — | 1162 | 2400 | Bussman 170M7107 (2) | 22,400 (3) | 0 |
| | | — | 900 | 1038 | 2400 | Bussman 170M7107 (2) | | |
| M1K1 | 13 | 1100 | — | 1331 | 2400 | Bussman 170M7107 (2) | 22,400 (3) | 0 |
| | | — | 1000 | 1162 | 2400 | Bussman 170M7107 (2) | | |
| M1K5 | 14 | 1500 | — | 1766 | — | Bussman 170M8610 (2) | 44,800 (4) | 0 |
| | | — | 1300 | 1530 | — | Bussman 170M8610 (2) | | |
| M1K9 | 14 | 1800 | — | 2237 | — | Bussman 170M8610 (2) | 44,800 (4) | 0 |
| | | — | 1500 | 1766 | — | Bussman 170M8610 (2) | | |
| M2K2 | 14 | 2000 | — | 2649 | — | Bussman 170M8610 (2) | 44,800 (4) | 0 |
| | | — | 1800 | 2237 | — | Bussman 170M8610 (2) | | |

(1) 20DM820 drives (ND) are only capable of producing 95% of starting torque under 10 Hz.

(2) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(3) This listed capacitance is for Frame 13 DC fed drives. For Frame 13 AC fed drives, the capacitance is 26,800 µF

(4) The listed capacitance is for Frame 14 DC fed drives. For Frame 14 AC fed drives, the capacitance is 53,600 µF.

**Table 29 - PowerFlex 700L Drives — Frames 3A and 3B, 932V DC Input Fuses**

| Drive Cat. No. 20L… | Frame Size | kW Rating | | DC Input Rating | Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | Amps | Catalog No. | | |
| F380 | 3A | 355 | 260 | 760 (1) | 1250 | Bussman 170M6700 (2) (3) | 10,800 | 1,080 (6) |
| F705 | 3B | 657 | 485 | 705 | 1100 | Bussman 170M6699 (3) (4) | 21,600 (5) | 2,160 (6) |
| F1K0 | 3B | 980 | 720 | 1050 | 800 (2 per phase) | Bussman 170M6696 (3) | 21,600 (5) | 2,160 (6) |

(1) Only the Dual Inverter for PowerFlex 700L Frame 3A is available as a DC input inverter.

(2) Two 630A Bussmann 170M6694 fuses per phase can also be used.

(3) See Fuse Certification and Test Data on page 129 for fuse self-certification and test data for Bussmann 170M and JKS fuses recommended for the DC bus fusing.

(4) Two 550A Bussmann 170M6693 fuses per phase can also be used.

(5) This 21,600 µF is the drive DC bus capacitance for a complete Frame 3B drive. The Frame 3B DC input inverter bus capacitance is 10,800 µF.

(6) This value applies to the precharge of the Frame 3A and 3B complete regenerative drives. There is a field-installed input filter precharge resistor kit (20L-RESPRE-A1) for the Frame 3A and 3B complete drives that can be used to increase the maximum external DC bus capacitance. For details, see publication 20L-IN010.

**Table 30 - PowerFlex 750-Series Drives — Frames 6 and 7, 932V DC Input Fuses**

| Drive Cat. No. 20F…/20G… | Frame Size | kW Rating | | DC Input Rating | | Non-Time Delay Fuse | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | kW | Amps | Catalog No. | | |
| F012 | 6 | 7.5 | — | 13.2 | 12.3 | 20 | Ferraz Shawmut HSJ20 (1) | 5200 | 1300 |
| | | — | 5.5 | 9.9 | 9.2 | 15 | Ferraz Shawmut HSJ15 (1) | | |
| F015 | 6 | 11 | — | 16.5 | 15.4 | 25 | Ferraz Shawmut HSJ25 (1) | 5200 | 1300 |
| | | — | 7.5 | 13.2 | 12.3 | 20 | Ferraz Shawmut HSJ20 (1) | | |
| F020 | 6 | 15 | — | 21.9 | 20.4 | 35 | Ferraz Shawmut HSJ35 (1) | 5200 | 1300 |
| | | — | 11 | 16.5 | 15.4 | 25 | Ferraz Shawmut HSJ25 (1) | | |
| F023 | 6 | 18.5 | — | 25.2 | 23.5 | 40 | Ferraz Shawmut HSJ40 (1) | 5200 | 1300 |
| | | — | 15 | 21.9 | 20.4 | 35 | Ferraz Shawmut HSJ35 (1) | | |
| F030 | 6 | 22 | — | 32.9 | 30.7 | 50 | Ferraz Shawmut HSJ50 (1) | 5200 | 1300 |
| | | — | 18.5 | 25.2 | 23.5 | 40 | Ferraz Shawmut HSJ40 (1) | | |
| F034 | 6 | 30 | — | 37.3 | 34.8 | 60 | Ferraz Shawmut HSJ60 (1) | 5200 | 1300 |
| | | — | 22 | 32.9 | 30.7 | 50 | Ferraz Shawmut HSJ50 (1) | | |
| F046 | 6 | 37 | — | 50.5 | 47.1 | 80 | Ferraz Shawmut HSJ80 (1) | 5200 | 1300 |
| | | — | 30 | 37.5 | 34.8 | 60 | Ferraz Shawmut HSJ60 (1) | | |
| F050 | 6 | 45 | — | 54.8 | 51.1 | 90 | Ferraz Shawmut HSJ90 (1) | 2600 | 650 |
| | | — | 37 | 50.5 | 47.1 | 80 | Ferraz Shawmut HSJ80 (1) | | |
| F061 | 6 | 55 | — | 66.9 | 62.4 | 100 | Ferraz Shawmut HSJ100 (1) | 5200 | 1300 |
| | | — | 45 | 54.8 | 51.1 | 90 | Ferraz Shawmut HSJ90 (1) | | |
| F082 | 6 | 75 | — | 89.9 | 83.8 | 150 | Ferraz Shawmut HSJ150 (1) | 5200 | 1300 |
| | | — | 55 | 66.9 | 62.4 | 100 | Ferraz Shawmut HSJ100 (1) | | |
| F098 | 6 | 90 | — | 107.5 | 100.2 | 175 | Ferraz Shawmut HSJ175 (1) | 5200 | 1300 |
| | | — | 75 | 89.9 | 83.8 | 150 | Ferraz Shawmut HSJ150 (1) | | |
| F119 | 6 | 110 | — | 130.5 | 121.6 | 200 | Ferraz Shawmut HSJ200 (1) | 5200 | 1300 |
| | | — | 90 | 107.5 | 100.2 | 175 | Ferraz Shawmut HSJ175 (1) | | |
| F142 | 6 | 132 | — | 155.7 | 145.1 | 250 | Ferraz Shawmut HSJ250 (1) | 5200 | 1300 |
| | | — | 110 | 130.5 | 121.6 | 200 | Ferraz Shawmut HSJ200 (1) | | |
| F171 | 7 | 160 | — | 187.5 | 174.8 | 300 | Ferraz Shawmut HSJ300 (1) | 11,700 | 2925 |
| | | — | 132 | 155.7 | 145.1 | 250 | Ferraz Shawmut HSJ250 (1) | | |
| F212 | 7 | 200 | — | 232.5 | 216.7 | 350 | Ferraz Shawmut HSJ350 (1) | 11,700 | 2925 |
| | | — | 160 | 187.5 | 174.8 | 300 | Ferraz Shawmut HSJ300 (1) | | |
| F263 | 7 | 250 | — | 288.4 | 268.8 | 500 | Ferraz Shawmut HSJ500 (1) | 11,700 | 2925 |
| | | — | 200 | 232.5 | 216.7 | 350 | Ferraz Shawmut HSJ350 (1) | | |

(1) A test program was developed to confirm that the HSJ (High Speed J) fuses can meet or exceed the requirements set forth by Allen-Bradley for the fuses on the common DC bus for all Allen-Bradley PowerFlex drives, 1336 Plus drives, and so forth. The criteria for acceptance was:

- 600V AC rectified, 810V DC average, fuses located at (+) and (-) leg. Short circuit test at 65 kVA.
- Time constant minimum 3 milliseconds (maximum 15 milliseconds).
- No over-load protection required.
- Let thru must be less than rating of the conductors.

This testing is listed in UL file E2137 Vol2 Sec 31 page 1 and in CSA report 1662646.

**Table 31 - PowerFlex 750-Series Drives — Frames 8…10, 932V DC Input Fuses**

| Drive Cat. No. 20G…[1] | Frame Size | kW Rating | | DC Input Rating | | Drive DC Bus Capacitance (µF) | Maximum External DC Bus Capacitance (µF) |
|---|---|---|---|---|---|---|---|
| | | ND | HD | Amps | kW | | |
| F265 | 8 | 250 | — | 292 | 272.1 | 16,800 | 46,200 |
| | | — | 200 | 237 | 220.9 | | |
| F330 | 8 | 315 | — | 363 | 338.3 | 16,800 | 46,200 |
| | | — | 250 | 292 | 272.1 | | |
| F370 | 8 | 355 | — | 407 | 379.3 | 16,800 | 46,200 |
| | | — | 300 | 339 | 315.9 | | |
| F415 | 8 | 400 | — | 457 | 425.9 | 25,200 | 69,300 |
| | | — | 355 | 407 | 379.3 | | |
| F460 | 8 | 450 | — | 506 | 471.6 | 25,200 | 69,300 |
| | | — | 375 | 413 | 384.9 | | |
| F500 | 8 | 500 | — | 550 | 512.6 | 25,200 | 69,300 |
| | | — | 400 | 454 | 423.1 | | |
| F590 | 9 | 560 | — | 649 | 604.9 | 33,600 | 29,400 |
| | | — | 450 | 506 | 471.6 | | |
| F650 | 9 | 630 | — | 715 | 666.4 | 33,600 | 29,400 |
| | | — | 500 | 550 | 512.6 | | |
| F710 | 9 | 710 | — | 781 | 727.9 | 33,600 | 29,400 |
| | | — | 590 | 649 | 604.9 | | |
| F765 | 9 | 750 | — | 842 | 784.7 | 50,400 | 44,100 |
| | | — | 630 | 715 | 666.4 | | |
| F795 | 9 | 800 | — | 875 | 815.5 | 50,400 | 44,100 |
| | | — | 710 | 825 | 768.9 | | |
| F960 | 9 | 900 | — | 1056 | 984.2 | 50,400 | 44,100 |
| | | — | 800 | 875 | 815.5 | | |
| F1K0 | 10 | 1000 | — | 1144 | 1066.2 | 50,400 | 12,600 |
| | | — | 900 | 952 | 887.3 | | |
| F1K4 | 10 | 1400 | — | 1540 | 1435.3 | 75,600 | 18,900 |
| | | — | 1120 | 1276 | 1189.2 | | |

(1) These drive have factory-installed fusing.

## Fuse Certification and Test Data

The following are copies of self-certification letters and test data for JKS and 170M fuses recommended in the previous tables in this Appendix for DC input fusing.

Configuration A indicates one fuse in the (+) leg and one fuse in the (-) leg of the DC bus.

### JKS Fuses

Cooper Bussmann
P. O. Box 14460
St. Louis, MO 63178-4460

January 25, 2002

Sr. Project Engineer
Rockwell Automation
6400 West Enterprise Drive
P.O. Box 760
Mequon, WI 53092

Subject: DC Testing for JKS Fuses

Dear Mr.

Per Rockwell Automation's request, Bussmann has completed the DC testing for the JKS fuses and is please to present the attached information indicating successful 'Self Certification DC Rating' on all subject fuses.

Bussmann tested fuses to the following parameters specified by Rockwell Automation:

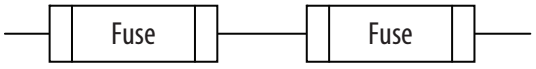
| | | |
|---|---|---|
| Short Circuit Current | = | 65 kA |
| Voltage | = | 810V DC |
| Time Constant | ≥ | 0.4 ms |

Additional tests were performed for acceptability.

| | | |
|---|---|---|
| Short Circuit Current | ≅ | 30 times fuse amperage |
| Voltage | = | 810V DC |
| Time Constant | ≥ | 0.4 ms |

The attached table identifies the fuses tested, the actual circuit parameters and the circuit configuration. In the attached table, the Interrupting Amps column specifies the fuses minimum and maximum amps the fuse will safely clear at 810V DC.

Circuit Configuration A




By way of this correspondence, Cooper Bussmann self-certifies the above fuses in end-user applications to the above parameters and the attached data sheet.

Should you have any questions regarding this correspondence, please contact me at the listed address and numbers below.

Regards,

Strategic OEM Accounts Manager
Cooper Bussmann

**Cooper Bussmann JKS**
**DC Fuse Test for Rockwell Automation**

| Fuse | Results | Circuit Parameters | | | | |
|---|---|---|---|---|---|---|
| | | Interrupting Amps | | Volts DC | Time Constant | Circuit Configuration |
| | | Min | Max | | | |
| JKS-(3A…15A) | Acceptable | — | 69.6 kA | 810 | 2.78 ms | Configuration A |
| JKS-(3A…15A) | Acceptable | 375 A | — | 810 | 0.55 ms | Configuration A |
| | | | | | | |
| JKS-(20A…30A) | Acceptable | — | 69.6 kA | 816 | 2.78 ms | Configuration A |
| JKS-(20A…30A) | Acceptable | 920 A | — | 812 | 0.4 ms | Configuration A |
| | | | | | | |
| JKS-(35A…60A) | Acceptable | — | 69.6 kA | 816 | 2.78 ms | Configuration A |
| JKS-(35A…60A) | Acceptable | 1820 A | — | 812 | 0.5 ms | Configuration A |
| | | | | | | |
| JKS-(70A…100A) | Acceptable | — | 69.6 kA | 816 | 2.78 ms | Configuration A |
| JKS-(70A…100A) | Acceptable | 2950 A | — | 812 | 0.86 ms | Configuration A |
| | | | | | | |
| JKS-(110A…200A) | Acceptable | — | 69.6 kA | 816 | 2.78 ms | Configuration A |
| JKS-(110A…200A) | Acceptable | 5960 A | — | 810 | 3.34 ms | Configuration A |
| | | | | | | |
| JKS-(225A…400A) | Acceptable | — | 69.6 kA | 816 | 2.78 ms | Configuration A |
| JKS-(225A…400A) | Acceptable | 11.5 kA | — | 812 | 2.92 ms | Configuration A |
| | | | | | | |
| JKS-(450A…600A) | Acceptable | — | 69.6 kA | 816 | 2.78 ms | Configuration A |
| JKS-(450A…600A) | Acceptable | 15.5 kA | — | 810 | 0.4 ms | Configuration A |

## 170M Fuses

Cooper Bussmann
P. O. Box 14460
St. Louis, MO 63178-4460

May 15, 2002

Sr. Project Engineer
Rockwell Automation
6400 West Enterprise Drive
P.O. Box 760
Mequon, WI 53092

Subject: DC Testing for 170M Fuses

Dear Mr.

Per Rockwell Automation's request, Bussmann has completed the DC testing for the 170M fuses and is please to present the attached information indicating successful 'Self Certification DC Rating' on all subject fuses.

Bussmann tested fuses to the following parameters specified by Rockwell Automation:

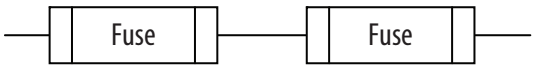
| | | |
|---|---|---|
| Short Circuit Current | = | 65 kA and 100 kA |
| Voltage | = | 810V DC |
| Time Constant | ≥ | 0.4 ms |

Additional tests were performed for acceptability.

| | | |
|---|---|---|
| Short Circuit Current | ≅ | 30 times fuse amperage as minimum current interrupting rating or as tested |
| Voltage | = | 810V DC |
| Time Constant | ≥ | 0.4 ms |

The attached table identifies the fuses tested, the actual circuit parameters and the circuit configuration. In the attached table, the Interrupting Amps column specifies the fuses minimum and maximum amps the fuse will safely clear at 810V DC.

Circuit Configuration A




By way of this correspondence, Cooper Bussmann self-certifies the above fuses in end-user applications to the above parameters and the attached data sheet.

Should you have any questions regarding this correspondence, please contact me at the listed address and numbers below.

Regards,

Strategic OEM Accounts Manager
Cooper Bussmann

### Cooper Bussmann 170M
### DC Fuse Test for Rockwell Automation

| Fuse | Results | Circuit Parameters | | | | |
|---|---|---|---|---|---|---|
| | | Interrupting Amps | | Volts DC | Time Constant | Circuit Configuration |
| | | Min | Max | | | |
| 170M6646 | Acceptable | — | 69.8 kA | 812 | 2 ms | Configuration A |
| 170M6646 | Acceptable | 10.2 kA | — | 812 | 1.66 ms | Configuration A |
| | | | | | | |
| 170M6650 | Acceptable | — | 69.6 kA | 812 | 2 ms | Configuration A |
| 170M6650 | Acceptable | 21.1 kA | — | 812 | 1.2 ms | Configuration A |
| | | | | | | |
| 170M7510 | | — | 65 kA | 810 | 2 ms | |
| 170M7510 | | 20 kA | — | 810 | 2 ms | |
| | | | | | | |
| 170M6792 | | — | 65 kA | 810 | 2 ms | |
| 170M6792 | | 19 kA | — | 810 | 2 ms | |
| | | | | | | |
| 170M6793 | | — | 65 kA | 810 | 2 ms | |
| 170M6793 | | 23 kA | — | 810 | 2 ms | |
| | | | | | | |
| 170M6794 | | — | 65 kA | 810 | 2 ms | |
| 170M6794 | | 27.5 kA | — | 810 | 2 ms | |
| | | | | | | |
| 170M6828 | | — | 65 kA | 810 | 2 ms | |
| 170M6828 | | 37 kA | — | 810 | 2 ms | |
| | | | | | | |
| 170M6934 | Acceptable | — | 105.4 kA | 810 | 1.8 ms | Configuration A |
| 170M6934 | Acceptable | 45.2 kA | — | 810 | 1.12 ms | Configuration A |
| | | | | | | |
| 170M7560 | | — | 100 kA | 810 | 2 ms | |
| 170M7560 | | 60 kA | — | 810 | 2 ms | |

# Power Component Accessories

## Back-to-Back Diodes (Shared AC/DC Configurations)

### Considerations

Consider the following information when selecting the Back-to-Back diodes:

- Size Back-to-Back diodes to 125% of the drive's DC input Amps
- Thermal impedance of panel to air
- Ambient temperature
- Any existing thermal compound between diodes and panel affecting thermal drop between the diodes and panel
- Consult diode vendor for proper diode installation

### Diode Sharing Modules

Consider the following information when selecting Diode Sharing Modules for the Shared Regenerative Braking Configuration shown in Figure 33 on page 52, Figure 35 on page 54, Figure 37 on page 61, and Figure 38 on page 62. The following table lists Diode Sharing Modules offered by Bonitron at www.bonitron.com

**Table 32 - Bonitron M3345D Diode Sharing Modules**

| Nominal Drive HP | | Max. Regen Amps | Drive DC Bus Amps | Max. No. of Drives | Model Number |
|---|---|---|---|---|---|
| 230V AC | 460V AC | | | | |
| 1.5 HP | 3 HP | 30 A | 4 A | 6 | M3345D-04F6 |
| 3 HP | 5 HP | 30 A | 10 A | 3 | M3345D-10H3 |
| 3 HP | 5 HP | 60 A | 10 A | 6 | M3345D-10J6 |
| 10 HP | 20 HP | 90 A | 30 A | 3 | M3345D-30H3 |
| 10 HP | 20 HP | 90 A | 30 A | 6 | M3345D-30J6 |
| 20 HP | 40 HP | 90 A | 60 A | 3 | M3345D-60L3 |
| 20 HP | 40 HP | 90 A | 60 A | 4 | M3345D-60P4 |
| 20 HP | 40 HP | 90 A | 60 A | 6 | M3345D-60P6 |
| 30 HP | 60 HP | 90 A | 90 A | 2 | M3345D-90N2 |
| 30 HP | 60 HP | 90 A | 90 A | 3 | M3345D-90N3 |
| 20 HP | 40 HP | 90 A | 60 A | 2 | M3345D-60L2 |
| 50 HP | 100 HP | 120 A | 200 A | 2 | M3345D-200P2 |

## HF Filter (SCR Bus Supply)

When the 20S-RFC filter is used, the HF emission limits for class A, group 2* (EN55011) in the second environment (industrial supply network) according to the product standard EN61800-3 are met, and the Bus Supply fulfills CE conformity.

| Description | Cat. No. |
|---|---|
| HF Filter, 690V | 20S-RFC |

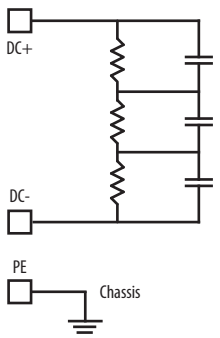
## Bus Supply Capacitors

### SCR Bus Supply Minimum Capacitance

A minimum capacitance is required to commission and test the SCR bus supply. If this minimum capacitance is not present, the bus supply internal fault detection circuit interprets the condition as a DC bus short and stops pulse firing. This minimum capacitance can be provided by a drive as long as it remains connected to the DC bus, or by a capacitor bank of at least 110 µF per SCR Bus Supply.

### Connecting High Power Drives and Low Power Drives on the DC Bus

**IMPORTANT** When the DC bus system is comprised of drives from the same product family and the same frame size, no additional capacitance is required. However, if drives from different product families or frame sizes are intermixed, the drive bus capacitance per amp ratio must be reviewed for compatibility.




All drives have a DC bus capacitance that is proportional to the drives power rating. When used in a common DC bus configuration, these capacitors are directly connected in parallel resulting in the DC bus ripple being shared proportionally to the power rating of the drive. When the ratio of the capacitance to the drive rated current is consistent, the best DC bus ripple sharing is promoted. The target ratio is 40 µF/A or greater.

Therefore it is important to evaluate every common DC bus drive system for any mismatch. When a mismatch is found, the use of an external capacitor bank is required. The capacitor bank must be connected closest to the DC bus terminals of the largest drive.

Calculate the capacitance (µF) per drive current rating (Amp) using Equation 1 below, where the DC input current and drive capacitance values are found in Appendix A.

**Equation 1**

$$\text{Capacitance Ratio} = \frac{\text{Drive Capacitance in Microfarads (µF)}}{\text{Drive DC Input Current in Amps (A)}}$$

If the ratio is below 40 µF/A, then additional capacitance is required and can be calculated using the following Equation 2.

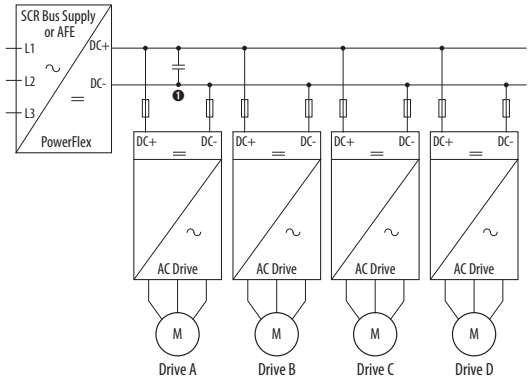
**Equation 2**

**Additional Capacitance = 40 µF x DC Input Amps - Drive DC Bus Capacitance**

Fuse protection with diagnostic feedback is recommended and may be located internal or external to the capacitor bank. Follow the manufacturer's recommendation regarding wire length and mounting of the capacitor bank.

**IMPORTANT** The capacitor quantity and configuration will vary based on the total capacitance and DC bus voltage rating.

Here are some example calculations.




❶ If a capacitor bank is required, place the capacitor bank as close as possible to the largest drive.

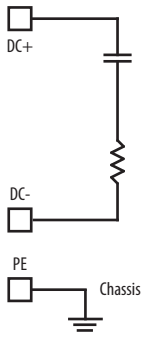
| Example 1: 650V DC | Drive A | Drive B | Drive C | Drive D |
|---|---|---|---|---|
| Product Family and Frame Size | PowerFlex 750-Series Frame 8 | PowerFlex 750-Series Frame 6 | PowerFlex 750-Series Frame 3 | PowerFlex 750-Series Frame 2 |
| Cat. No. | D545… | D248… | D034… | D022… |
| DC Current (from Appendix A) | 599 A | 272.1 A | 36.4 A | 23.3 A |
| DC Bus Capacitance (from Appendix A) | 23,700 µF | 9200 µF | 1500 µF | 1000 µF |
| µF/A Ratio (use Equation 1) | 39.5 | 33.8 | 41.2 | 42.9 |
| Additional Capacitance Required | No | Yes | No | No |
| Additional Capacitance µF Value (use Equation 2) | n/a | 1648 µF | n/a | n/a |

| Example 2: 650V DC | Drive A | Drive B | Drive C | Drive D |
|---|---|---|---|---|
| Product Family and Frame Size | PowerFlex 700S Frame 13 | PowerFlex 700S Frame 6 | PowerFlex 700S Frame 5 | PowerFlex 700S Frame 5 |
| Cat. No. | J1K0… | J248… | J140… | J140… |
| DC Current (from Appendix A) | 1162 A | 272 A | 137A | 137 A |
| DC Bus Capacitance (from Appendix A) | 19,800 µF | 8400 µF | 6000 µF | 6000 µF |
| µF/A Ratio (use Equation 1) | 17.0 | 30.8 | 43.7 | 43.7 |
| Additional Capacitance Required | Yes | Yes | No | No |
| Additional Capacitance µF Value (use Equation 2) | 26,680 µF | 2480 µF | n/a | n/a |

Supplier Reference: Contact factory for part number 30339-304-x, or contact a capacitor bank manufacturer for recommendations.

## RC Snubber Circuit

Fuse protection with diagnostic feedback is recommended and may be internal or external to the RC snubber. Follow the manufacturer's recommendation when mounting the RC snubber regarding wire length and thermal constraints due to the wattage rated components.




The specifications for the snubber are:

R = 10 ohm, 100 W, low inductance (less than 50 μH)
C = 20 μF, 2000V

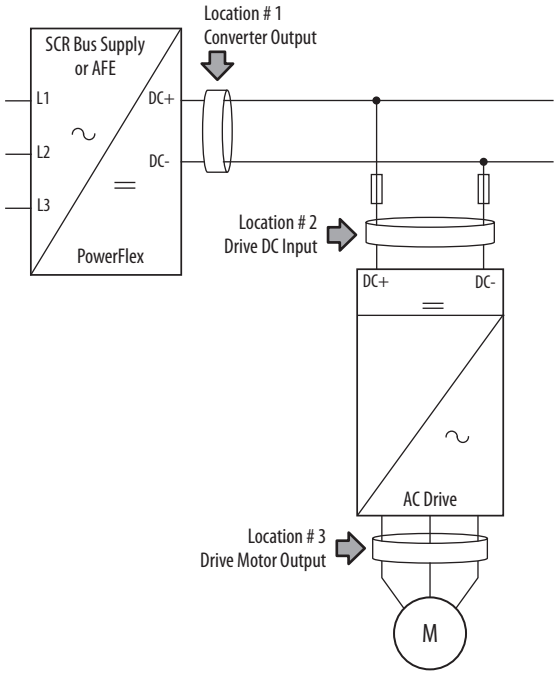
Contact Bonitron for an RC snubber circuit at www.bonitron.com.

## Common Mode Core

The common mode core (CMC) is a passive ring or disk shaped filter compromised of ferrite material that is designed to attenuate any high frequency transient or disturbance on the wire or cable passing through it, minimizing the risk of common mode interference to other circuitry.

The common mode core can be installed in one of three locations and are shown in the diagram below.

**Figure 56 - Common Mode Core Locations**




### Usage With SCR Bus Supply

The common mode core mounting location (SCR Bus Supply DC output, drive DC input, or drive motor output) changes for different common bus

configurations. For systems with SCR bus supplies, the common mode core is placed at **either** the DC input terminals of each drive **or** at the motor output of each drive. See Figure 56 for the mounting locations.

| Drive Product Family | SCR Bus Supply DC Output Location # 1 | Drive DC Input Location # 2 (1) | Drive Motor Output Location # 3 (2) |
|---|---|---|---|
| PowerFlex 750-Series | N/A | A common mode core is included for use on the AC line input when ordering a Catalog No. 21G drive with a 'P' or 'W' enclosure. A Common Mode Core is also included with any of the following IP00 Input Termination kits:<br>• 20-750-BUS5-F8<br>• 20-750-BUS5-F9<br>• 20-750-BUS5-F10 | Fr. 1…3: 1321-M048<br>Fr. 4…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: 20-750-EMCCM1-F8 |
| PowerFlex 700H/PowerFlex 700S Frames 9…14 | N/A | 30339-319-01 | N/A |
| PowerFlex 700/PowerFlex 700S Frames 0…6 | N/A | N/A | N/A |
| Other drives | Contact Factory | Contact Factory | Contact Factory |

(1) One common mode core at each drive DC input
(2) One common mode core at each drive motor output.

## Usage With AFE

The common mode core mounting location (AFE DC output, drive DC input, or drive motor output) changes for different common bus configurations. For systems with AFE bus supplies, the common mode core is placed at the DC output terminals of each AFE **and** drive DC input terminals **or** at the motor output of each drive. See Figure 56 for the mounting locations.

| Drive Product Family | AFE DC Output Location # 1 (3) | Drive DC Input Location # 2 (4) | Drive Motor Output Location # 3 (5) |
|---|---|---|---|
| PowerFlex 750-Series | AFE Fr. 10: 30201-031-01<br>AFE Fr. 13: 30339-319-01 | A common mode core is included for use on the AC line input when ordering a Catalog No. 21G drive with a 'P' or 'W' enclosure. A Common Mode Core is also included with any of the following IP00 Input Termination kits:<br>• 20-750-BUS5-F8<br>• 20-750-BUS5-F9<br>• 20-750-BUS5-F10 | Fr. 1…3: 1321-M048<br>Fr. 4…6: 1321-M180<br>Fr. 7: 30201-031-01<br>Fr. 8…10: 20-750-EMCCM1-F8 (6) |
| PowerFlex 700H/PowerFlex 700S Frames 9…14 (1) (2) | AFE Fr. 10: 30201-031-01<br>AFE Fr. 13: 30339-319-01 | 30339-319-01 | Fr. 9…13: 30201-031-01 or 1321-M670 |
| PowerFlex 700/PowerFlex 700S Frames 0…6 | AFE Fr. 10: 30201-031-01<br>AFE Fr. 13: 30339-319-01 | N/A | N/A |
| Other drives | Contact Factory | Contact Factory | Contact Factory |

(1) For a single PowerFlex 700H/700S Frame 9…14 drive, the AFE DC output common mode core is not required if a common mode core is installed at the DC input of the PowerFlex 700H/700S Frame 9…14 drive—however, the drive motor output common mode core is always required.
(2) For multiple PowerFlex 700H/700S Frame 9…14 drives, the AFE DC output common mode core is required and either the common mode core on the drive DC input or the drive motor output of the PowerFlex 700H/700S Frame 9…14 drive is always required.
(3) One common mode core at each AFE DC output.
(4) One common mode core at each drive DC input.
(5) One common mode core at each drive motor output unless an output reactor dv/dt filter is used.
(6) For a single PowerFlex 750-Series Frame 8 drive, the AFE DC output common mode core is not required if a common mode core is installed at the DC input of the PowerFlex 750-Series Frame 8 drive.

A variety of core shapes are available to allow various arrangements of wire diameters and turns ratios.

## External Drive Options

The following external common mode core options are available.

| Option | Part No. | Additional Resources |
|---|---|---|
| 1 | 1321-M048 | See publication 1321-IN001 or publication 1321-TD001 for more information |
| 2 | 1321-M180 | |
| 3 | 1321-M670 | |
| 4 | 30201-031-01 | Contact factory for more information. See Figure 57 for design details. |
| 5 | 30339-319-01 | Contact factory for more information. See Figure 58 for design details. |
| 6 | 30339-320-01 | |

**Figure 57 - Drive Common Mode Core Option 4 (30201-031-01) Mounting Dimensions**

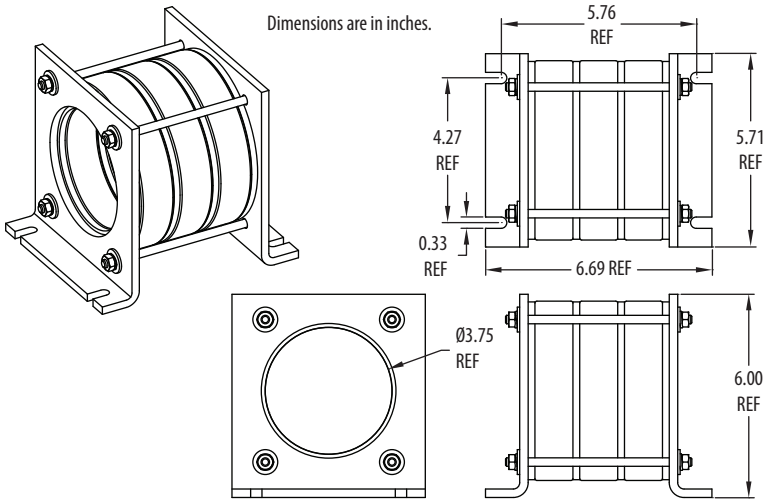
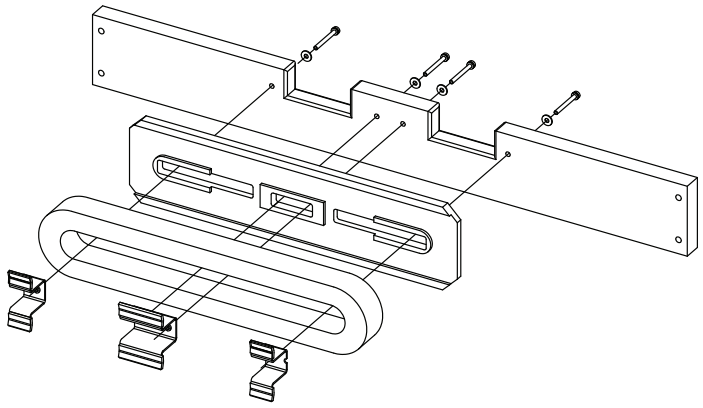



**Figure 58 - Drive Common Mode Core Options 5 and 6 (30339-319-01 and 30339-320-01) Exploded View**



## Internal Drive Options

The following internal common mode core options are available.

| Option | PowerFlex 750-Series Drive | Voltage | Part No. | Additional Resources |
|---|---|---|---|---|
| 5 | Frame Size 1 | 400/480 | 20-750-EMC1-F1 | See PowerFlex 750-Series EMC Plate and Core(s) - Frames 1…7 Installation Instructions, publication 750-IN006 for more details. |
| 6 | Frame Size 2 | 400/480 | 20-750-EMC1-F2 | |
| 7 | Frame Size 3 | 400/480 | 20-750-EMC1-F3 | |
| | | 600/690 | 20-750-EMC3-F3 | |
| 8 | Frame Size 4 | 400/480 | 20-750-EMC1-F4 | |
| | | 600/690 | 20-750-EMC3-F4 | |
| 9 | Frame Size 5 | 400/480 | 20-750-EMC1-F5 | |
| | | 600/690 | 20-750-EMC3-F5 | |
| 10 | Frame Size 6 in IP20 Enclosure | 600/690 (1) | 20-750-EMC3-F6 | |
| | Frame 6 in IP54 Enclosure | | 20-750-EMC5-F6 | |
| 11 | Frame Size 7 in IP20 Enclosure | 600/690 (1) | 20-750-EMC3-F7 | |
| | Frame 7 in IP54 Enclosure | | 20-750-EMC5-F7 | |
| 12 | Frame Size 8 | For Frames 8, 9, and 10 with enclosure code 'P' or 'W', the common mode core is included. For enclosure code 'T', the common mode core is included with termination kit 20-750-BUS5-F*. See publication 750-IN020 for more details. | | |
| 13 | Frame Size 9 | | | |
| 14 | Frame Size 10 | | | |

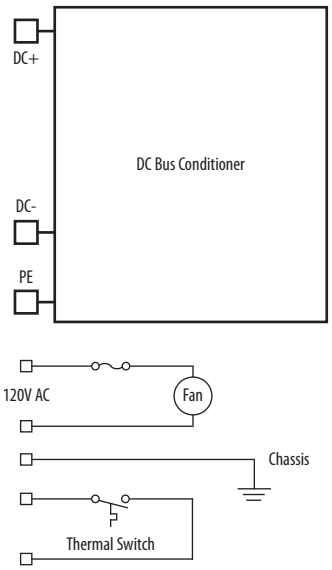
(1) Internal common mode core is not available for 400/480 volt products.

## DC Bus Conditioner—Designs A, B, C, D, or E

The DC bus conditioner is a device that is electrically connected across the +/- DC bus terminals and PE ground. A 120V AC internal fan provides internal circulating air to assist in thermal dissipation. An internal thermal switch provides overtemperature protection.

**IMPORTANT** Fuse protection with diagnostic feedback is recommended (100A, 1000V) and may be internal or external to the bus conditioner.

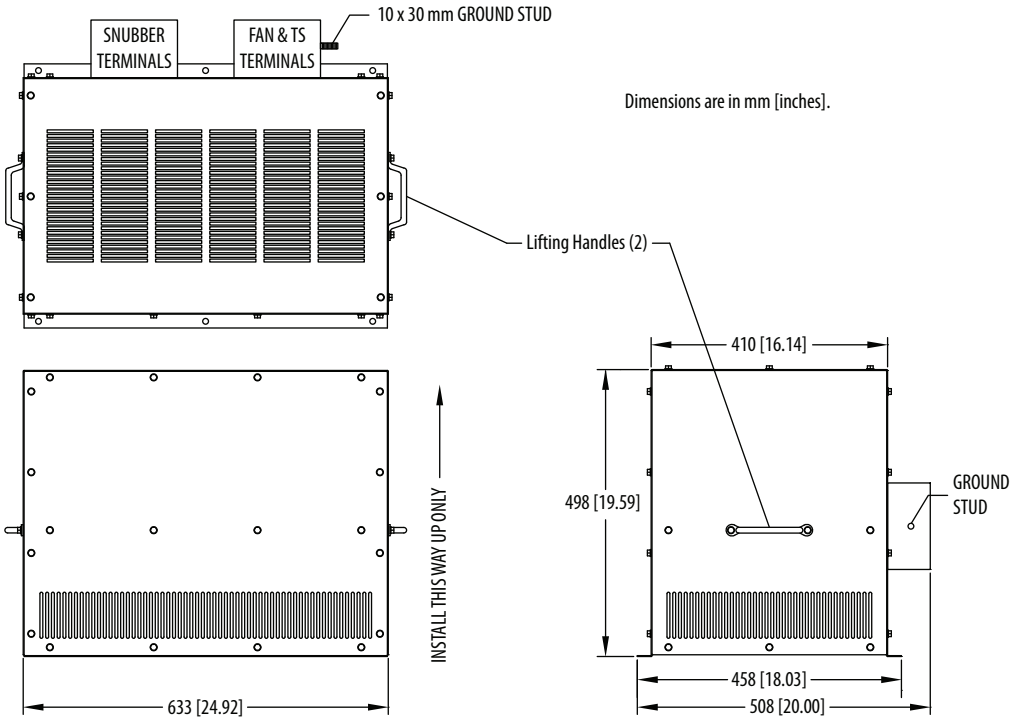
Follow the manufacturer's recommendation when mounting the DC bus conditioner regarding wire length and thermal constraints due to the high wattage rated components.



A warning label should be affixed to the bus conditioner similar to the one below.

**WARNING:** This conditioner is directly connected to the system's common DC Bus. The drive's disconnect switch will NOT disconnect power to this conditioner. Disconnect the DC source and the 120V AC source for the fan circuitry. Then measure the system DC bus voltage and the fan and thermal interlock system. They must be at zero before servicing this equipment.

A DC bus conditioner example is shown below.




## Design A

DC Bus Conditioner—600/690V, 20 μF, 6800 W

The NEMA 1 enclosure is 633 mm wide x 498 mm high x 508 mm deep and has a connection terminal box included. The 47 kg enclosure is designed to be externally mounted on top of the cabinet lineup.

Supplier Reference: Contact factory for PN-184456 or Byrne & Schaefer for SN-101204

**NOTE:** This product has been replaced with Design E.

## Design B

DC Bus Conditioner—400/480V, 20 µF, 6800 W

The NEMA 1 enclosure is 633 mm wide x 498 mm high x 508 mm deep and has a connection terminal box included. The 43 kg enclosure is designed to be externally mounted on top of the cabinet lineup.

Supplier Reference: Contact factory for PN-184460 or Bryne & Schaefer for SN-101203.

**NOTE:** This product has been replaced with Design E.

## Design C

DC Bus Conditioner—600/690V, 20 µF, 2000 W

The NEMA 1 enclosure is 453 mm wide x 465 mm high x 424 mm deep and has a connection terminal box included. The 30 kg enclosure is designed to be internal to the cabinet or externally mounted on top of the cabinet lineup.

Supplier Reference: Contact factory for PN-184462 or Bryne & Schaefer for SN-101202.

## Design D

DC Bus Conditioner—400/480V, 6 µF, 2000 W

The NEMA 1 enclosure is 453 mm wide x 465 mm high x 424 mm deep and has a connection terminal box included. The 29 kg enclosure is designed to be internal to the cabinet or externally mounted on top of the cabinet lineup.

Supplier Reference: Contact factory for PN-184465 or Bryne & Schaefer for SN-101201.

## Design E

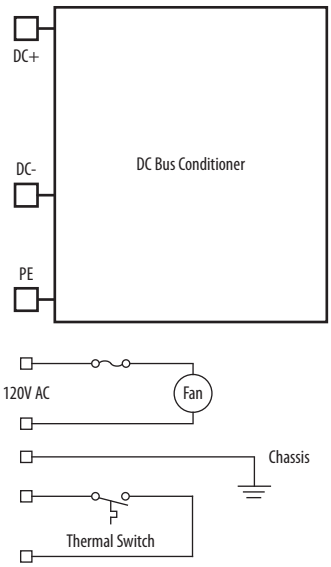
DC Bus Conditioner—480/575/600/690V, 20 µF, 6800 W

The NEMA 1 enclosure is 633 mm wide x 498 mm high x 508 mm deep and has a connection terminal box included. The 47 kg enclosure is designed to be externally mounted on top of the cabinet lineup.

Supplier Reference: Contact factory for PN-225798 or Bryne & Schaefer for SN-101260.

## DC Bus Clamp—Design F or G

The DC bus clamp is a device that is electrically connected across the +/- DC bus terminals and PE ground. A 120V AC internal fan provides internal circulating air to assist in thermal dissipation. An internal thermal switch provides overtemperature protection.




**IMPORTANT** Fuse protection with diagnostic feedback is recommended (100A, 1000V) and may be internal or external to the bus clamp.

Follow the manufacturer's recommendation when mounting the bus clamp regarding wire length and thermal constraints due to the high wattage rated components.

A warning label should be affixed to the bus clamp similar to the one below.

**WARNING:** This conditioner is directly connected to the system's common DC Bus. The drive's disconnect switch will NOT disconnect power to this conditioner. Disconnect the DC source and the 120V AC source for the fan circuitry. Then measure the system DC bus voltage and the fan and thermal interlock system. They must be at zero before servicing this equipment.

### Design F

DC Bus Clamp—400/480/600/690V, 5000 W

The NEMA 1 enclosure is 453 mm wide x 465 mm high x 424 mm deep and has a connection terminal box included. The 27 kg enclosure is designed to be externally mounted on top of the cabinet lineup.

Supplier Reference: Contact factory for PN-179166 or Bryne & Schaefer for SN-101206.

**NOTE:** This product has been replaced with Design G.

### Design G

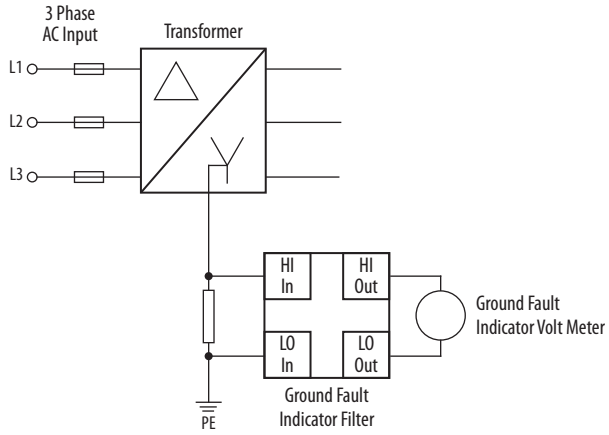
DC Bus Clamp—480/575/600/690V, 5 µF, 3000 W

The NEMA 1 enclosure is 453 mm wide x 465 mm high x 424 mm deep and has a connection terminal box included. The 27 kg enclosure is designed to be externally mounted on top of the cabinet lineup.

Supplier Reference: Contact factory for PN-239300 or Bryne & Schaefer for SN-101268.

## Ground Fault Indicator Filter

A ground fault occurs when there is an imbalance of current in a system. The sum of the currents entering the node must equal the sum leaving the node. The largest cause of the error is the leakage current through power devices and other high impedance paths to ground.




In high resistance or ungrounded systems, a ground fault sensor is placed across the resistor to sense or detect these currents. When the threshold has been exceeded, the sensor will provide an alarm output that can engage safety circuitry to disable a system.

The current waveform associated with a drive has a harmonic-rich current signature which can cause the ground fault indicator filter to trip. This filter is designed to average this signature, while still providing protection.

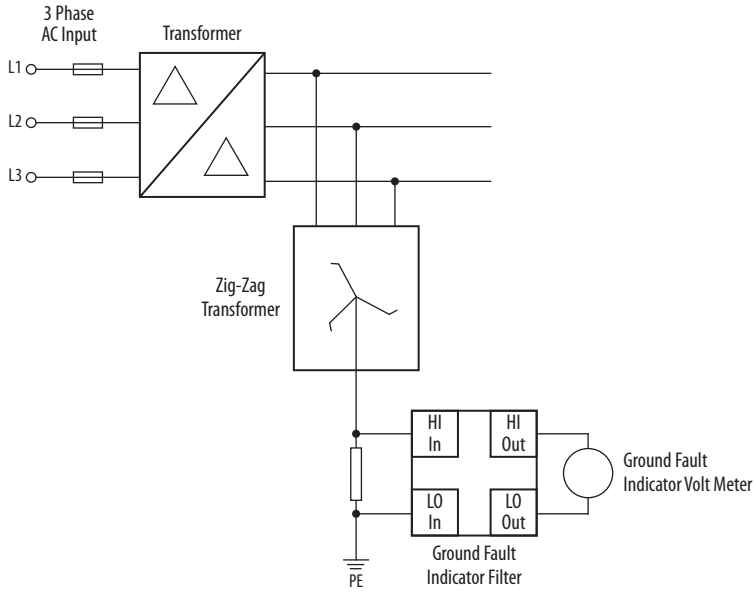
Follow the manufacturer's recommendation when mounting the ground fault indicator filter.

The NEMA 1 enclosure is 335 mm wide x 226 mm high x 335 mm deep, and weighs 26 kg.

Supplier Reference: Contact factory for PN-50085 or Bryne & Schaefer for ER-101011.

## Zig-Zag Transformer

When an ungrounded system is used for power distribution, a zig-zag transformer can be used to create an artificial neutral for sensing ground faults. A typical ground fault detection arrangement is with a zig-zag transformer sourcing a neutral resistor with a ground fault indicator filter sense circuit.




Contact the factory or a transformer manufacture for recommendations.

# 1336 REGEN Drives

This section is included only to support existing, installed systems with legacy (discontinued) 1336 REGEN drives from Rockwell Automation. The 1336 REGEN drives in this section are no longer available.

## Supported Products

At one time, the following products were supported.

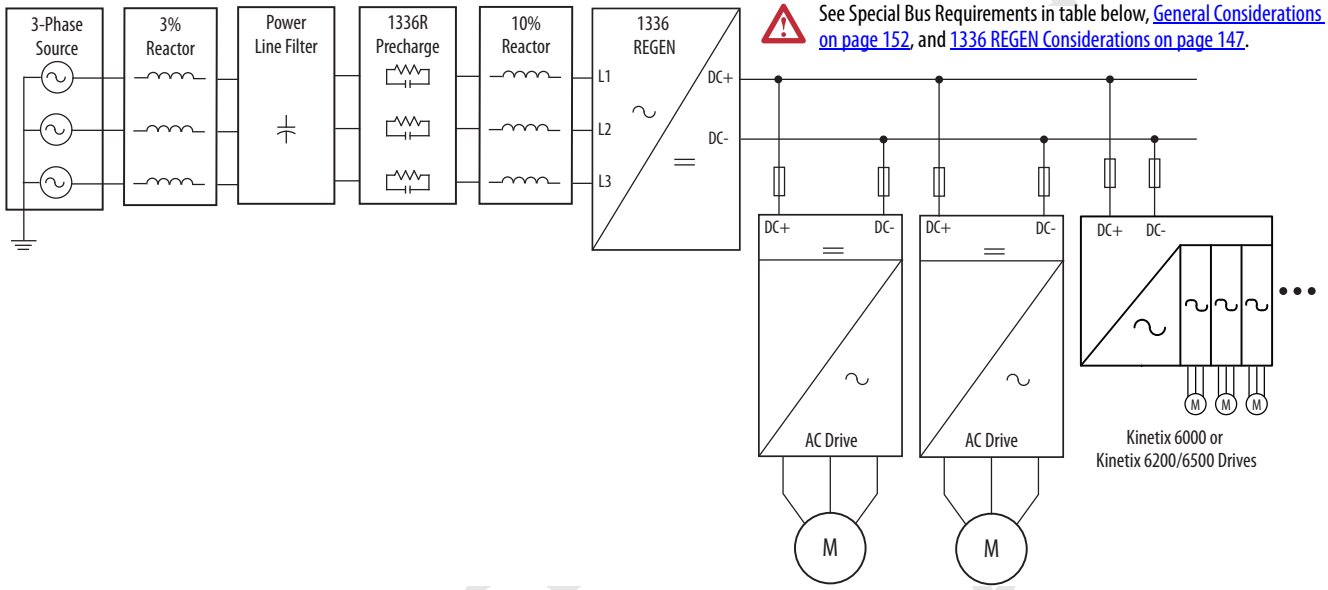
| Products | Supported Drives |
|---|---|
| 1336 REGEN (1) | PowerFlex 40P: All 400/480V AC power ratings |
| | PowerFlex 700 (2) / PowerFlex 700 Series B (2): 400/480V AC Frames 0…6 (3) |
| | PowerFlex 700S: 400/480V AC Frames 1…6 (3) |
| | PowerFlex 750-Series: Frames 1…7 (4) |
| | Kinetix 7000: BM06…BM12 |
| | Kinetix 6000 and Kinetix 6200/6500: All 460V configurations |

(1) The 1336 REGEN is not CE compliant.
(2) These drives require firmware revision 2.001 or later (Standard and Vector Control).
(3) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, PowerFlex 700H Frame 9…14, and PowerFlex 700L DC input drives are required when not connected to the AC source.
(4) PowerFlex 750-Series Frame 5…7 DC input version drives with precharge must be selected.

Discontinued
Discontinued

# Typical System Configurations

**Figure 59 - 1336 REGEN DC Bus Supply with AC Drives and Kinetix 6000 Drive System**




| Drawing Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive | PowerFlex 700/700S: Frames 0…4 | None |
| | PowerFlex 700/700S: Frames 5 and 6 | • Internal precharge option must be selected if a disconnect between the DC bus and the drive's DC input is used.<br>• DC input 'common bus' drives are required—not AC stand-alone configuration. |
| | PowerFlex 750-Series: Frames 1…4 | None |
| | PowerFlex 750-Series: Frames 5…7 | DC input version with precharge must be selected. |
| | Kinetix 7000: BM06…BM08 | None |
| | Kinetix 7000: BM09…BM12 | External precharge must be provided if a disconnect between the DC bus and the drive's DC input is used. |
| | PowerFlex 40P: All power ratings | **Important:** Do not use PowerFlex 40P or PowerFlex 520-Series drives on the same DC bus supply with PowerFlex 700/700H/700S/750-Series drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P or PowerFlex 520-Series drives compared to the PowerFlex 700/700H/700S/750-Series drives and Kinetix 7000 drives. |
| Kinetix 6000 and Kinetix 6200/6500 | Kinetix 6000 and Kinetix 6200/6500: All 460V configurations | Drives must be placed in a common bus follower configuration. |

Discontinued

## 1336 REGEN Considerations

1. The 1336 REGEN Parameter 1- [Operational Mode] must be set to 'DC Bus Supply Mode'.
2. The 3% reactor and power line filter are separately ordered items, but both are required when the supplying transformer impedance is more than 10% of the 10% line reactor impedance. See the table below for Power Line Filter part numbers. See the 1336 REGEN User Manual for 3% reactor part numbers.

| Description | Part Number |
|---|---|
| 460V, 48A, Open Style | 1321-VB048FLT-AN |
| 460V, 78A, Open Style | 1321-VB078FLT-AN |
| 460V, 180A, Open Style | 1321-VB180FLT-AN |

A 3% reactor is also required for use with the 1336 REGEN Power Line Filter. See the 1336 REGEN User Manual for reactor selection.

- Together with the 10% reactor, these components form an LCL (inductance, capacitance, inductance) type filter.
- Example calculation of 10% Reactor Impedance versus Transformer Impedance:

  Transformer is 200 kVA, 480V AC, 5% Impedance.

  180A Regen is used.

  Transformer Impedance in mH = $(Xpu \times VAC^2) / (2\pi \times f \times kVA \times 1000)$

  $= (0.05 \times 480^2) / (2 \times 3.14159 \times 60 \times 200 \times 1000) = 0.153$ mH

  0.153 / 0.430 = 0.36 = 36%, which is higher than 10%, requiring a power line filter.
- 10% Reactor Per Phase Inductances

  1321-3LRA048 1.6 mH
  1321-3LRA078 1.0 mH
  1321-3LRA180 0.430 mH

## Sizing

1. Convert all motor powers to kW (kW = HP x 0.746).
2. Determine the total power and input current required during acceleration(1).

   For Motoring Loads: $P_{DRIVE} = P_{MOTOR}$ / Motor Efficiency

   For Regenerating Loads: $P_{DRIVE} = P_{MOTOR}$ x Motor Efficiency

   $$P_{ACCEL} = P_{DRIVE1} + P_{DRIVE2} + ...$$

   Calculate the input current required on the regenerative unit during acceleration, taking advantage of the 110% for 1 minute overload rating of the regenerative unit:

   $$I_{INPUT} = P_{ACCEL} \times 1000 / (\sqrt{3} \times V_{LL} \times 1.1),$$

   where $P_{ACCEL}$ is in kW, and $V_{LL}$ = RMS line-to-line AC input voltage.

(1) $P_{MOTOR}$ is the motor power required for the application. The $P_{MOTOR}$ can be positive if that section of the machine is motoring or negative if that section of the machine is regenerating.

Discontinued
Discontinued

3. Determine the total power and input current required during steady state run operation(1).

   For Motoring Loads: $P_{DRIVE} = P_{MOTOR}$ / Motor Efficiency

   For Regenerating Loads: $P_{DRIVE} = P_{MOTOR}$ x Motor Efficiency

   $$P_{RUN} = P_{DRIVE1} + P_{DRIVE2} + ...$$

   Calculate the steady state input current required on the regenerative unit:

   $$I_{INPUT} = P_{RUN} \times 1000 / (\sqrt{3} \times V_{LL}),$$

   where $P_{RUN}$ is in kW, and $V_{LL}$ = RMS line-to-line AC input voltage.

4. Determine the total power and input current required during deceleration(1).

   For Motoring Loads: $P_{DRIVE} = P_{MOTOR}$ / Motor Efficiency

   For Regenerating Loads: $P_{DRIVE} = P_{MOTOR}$ * Motor Efficiency

   $$P_{DECEL} = P_{DRIVE1} + P_{DRIVE2} + ...$$

   Calculate the input current required on the regenerative unit during deceleration, taking advantage of the 110% for 1 minute overload rating of the regenerative unit:

   $$I_{INPUT} = P_{DECEL} \times 1000 / (\sqrt{3} \times V_{LL} \times 1.1),$$

   where $P_{DECEL}$ is in kW, and $V_{LL}$ = RMS line-to-line AC input voltage.

5. Compare the absolute values of the input current required for the regenerative unit during acceleration, deceleration, and steady state. Select the regenerative unit with the input current rating that meets or exceeds the worst case input current.

Example Calculation:

A machine contains 3 drives that are to be powered with a regenerative bus supply. The following motor powers were determined.

| Roll Name | Accel Power (HP) | Run Power (HP) | Decel Power (HP) |
|---|---|---|---|
| Feed Roll (DRIVE1) | -10 | -15 | -30 |
| Leveler (DRIVE2) | 75 | 50 | -75 |
| Winder (DRIVE3) | 20 | 12 | -30 |

Motor efficiencies were estimated at 85%. Line voltage is 480V AC.

**Step 1**

All motor powers were converted to kW.

| Roll Name | Accel Power (kW) | Run Power (kW) | Decel Power (kW) |
|---|---|---|---|
| Feed Roll (DRIVE1) | -7.5 | -11.2 | -22.4 |
| Leveler (DRIVE2) | 55.9 | 37.3 | -55.9 |
| Winder (DRIVE3) | 14.9 | 8.9 | -22.4 |

(1) $P_{MOTOR}$ is the motor power required for the application. The $P_{MOTOR}$ can be positive if that section of the machine is motoring or negative if that section of the machine is regenerating.

Discontinued
Discontinued

**Step 2**

Drive power was calculated for each roll during acceleration:

$P_{DRIVE1} = -7.5 \times 0.85 = -6.4$ kW
$P_{DRIVE2} = 55.9 / 0.85 = 65.8$ kW
$P_{DRIVE3} = 14.9 / 0.85 = 17.5$ kW

Total power during acceleration:

$P_{ACCEL} = (-6.4) + (65.8) + (17.5) = 76.9$ kW

Input current during acceleration:

$I_{INPUT} = 76.9 \times 1000 / (\sqrt{3} \times 480 \times 1.5) = 61.7$ Amps

**Step 3**

Drive power was calculated for each roll during steady state run conditions:

$P_{DRIVE1} = -11.2 \times 0.85 = -9.5$ kW
$P_{DRIVE2} = 37.3 / 0.85 = 43.9$ kW
$P_{DRIVE3} = 8.9 / 0.85 = 10.5$ kW

Total power during steady state run conditions:

$P_{ACCEL} = (-9.5) + (43.9) + (10.5) = 44.9$ kW

Input current during steady state run conditions:

$I_{INPUT} = 44.9 \times 1000 / (\sqrt{3} \times 480) = 54$ Amps

**Step 4**

Drive power was calculated for each roll during deceleration:

$P_{DRIVE1} = -22.4 \times 0.85 = -19.0$ kW
$P_{DRIVE2} = -55.9 \times 0.85 = -47.5$ kW
$P_{DRIVE3} = -22.4 \times 0.85 = -19.0$ kW

Total power during deceleration:

$P_{ACCEL} = (-19.0) + (-47.5) + (-19.0) = -85.5$ kW

Input current during deceleration:

$I_{INPUT} = -85.5 \times 1000 / (\sqrt{3} \times 480 \times 1.5) = -68.6$ Amps

**Step 5**

Comparing the absolute values of the input current required during acceleration, deceleration, and steady state, the largest value is 68.6 Amps. Select a regenerative unit with a current rating of 68.6 Amps or more.

# Fusing

## AC Input 1336 REGEN

See the 1336 REGEN User Manual for recommended AC input fusing of the 1336 REGEN.

Discontinued Discontinued

# 1336 REGEN Drive in Regenerative Braking Configuration

## System Characteristics

In the regenerative braking configuration the drive has a connection to the AC line and draws the majority of the motoring power. This allows the regenerative brake to be sized for the regenerative power only. The regenerative brake puts energy back onto the distribution system instead of dissipating energy with resistor braking technology.

## Supported Products

At one time, these products were supported.

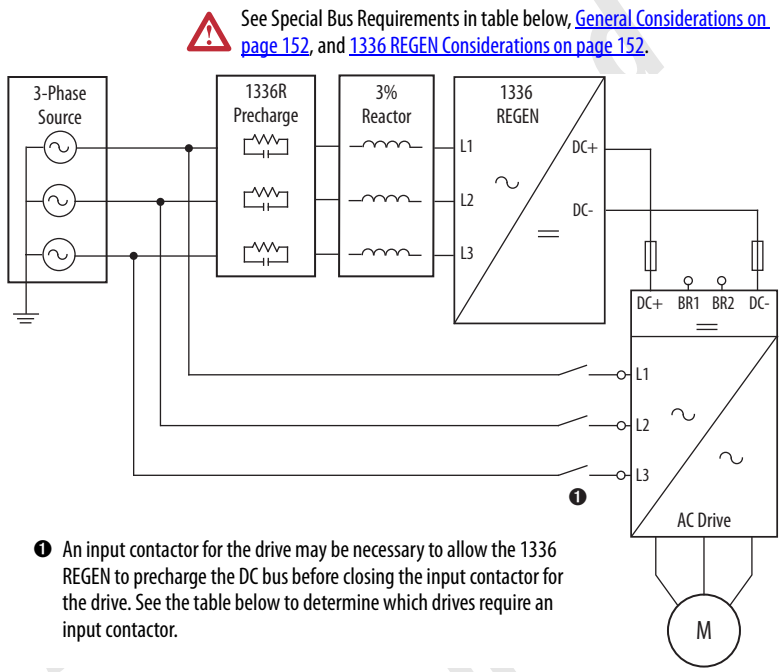
| Products | Supported Drives |
|---|---|
| 1336 REGEN (1) | PowerFlex 40P: All 400/480V AC power ratings |
| | PowerFlex 700 (2) / PowerFlex 700 Series B (2): All 400/480V AC frame sizes (3) |
| | PowerFlex 700S: All 400/480V AC frame sizes (3) |
| | PowerFlex 700H: All 400/480V AC frame sizes (3) |
| | PowerFlex 750-Series: Frames 1…7 (4) |
| | Kinetix 7000: BM06…BM12 |

(1) The 1336 REGEN is not CE compliant.
(2) These drives require firmware revision 2.001 or later (Standard and Vector Control).
(3) PowerFlex 700 Frame 5…10, PowerFlex 700S Frame 5 and 6 and Frame 9…14, and PowerFlex 700H Frame 9…14 DC input drives are required when not connected to the AC source.
(4) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

Discontinued
Discontinued

## Typical System Configurations

**Figure 60 - 1336 REGEN Brake with an AC Drive**


See Special Bus Requirements in table below, General Considerations on page 152, and 1336 REGEN Considerations on page 152.
3-Phase Source
1336R Precharge
3% Reactor
1336 REGEN
L1
L2
L3
DC+
DC-
DC+ BR1 BR2 DC-
L1
L2
L3
AC Drive
M
❶ An input contactor for the drive may be necessary to allow the 1336 REGEN to precharge the DC bus before closing the input contactor for the drive. See the table below to determine which drives require an input contactor.

| Dwg. Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive | PowerFlex 700/700S: Frames 0…2 | See item 2 in 1336 REGEN Considerations on page 152. |
| | PowerFlex 700/700S: Frames 3 and 4 | See item 3 in 1336 REGEN Considerations on page 152. |
| | PowerFlex 700/700S: Frames 5 and 6 | None |
| | PowerFlex 700: Frames 7…10 | |
| | PowerFlex 700/700S: Frames 9…14 | |
| | PowerFlex 750-Series: Frames 1…4 | See item 2 in 1336 REGEN Considerations on page 152. |
| | PowerFlex 750-Series: Frames 5…7 | A DC input terminal kit must be ordered for Frames 6 and 7. |
| | PowerFlex 40P: All power ratings | • See item 2 in 1336 REGEN Considerations on page 152.<br>• **Important:** Do not use PowerFlex 40P or PowerFlex 520-Series drives on the same DC bus supply with PowerFlex 700/700H/700S/750-Series drives or Kinetix 7000 drives. This is due to the difference in capacitance/amps of the PowerFlex 40P or PowerFlex 520-Series drives compared to the PowerFlex 700/700H/700S/750-Series drives and Kinetix 7000 drives. |
| | Kinetix 7000: BM06…BM12 | See item 2 in 1336 REGEN Considerations on page 152. |

Discontinued

## General Considerations

1. Disconnect the common mode capacitors from the drives when using a regenerative module. See the drive's documentation for instructions on disconnecting the common mode capacitors.
2. All system components (Bus Supply, PowerFlex Drives, and Braking Unit) must be selected for the same AC-line voltage.
3. A low inductance type DC bus must be used. See DC Bus Connections on page 15 for details.

## 1336 REGEN Considerations

1. The 1336 REGEN Parameter 1- [Operational Mode] must be set to 'Regen Brake Mode' (default).
2. When using a PowerFlex 40P, PowerFlex 700/700S Frame 0...2, PowerFlex 750-Series Frame 1...4, or Kinetix 7000 BM06...BM12 drive with a 1336 REGEN in the Regenerative Brake Configuration, an AC input contactor must be provided for the drive. The 1336 REGEN unit must be allowed to precharge the DC bus before closing the AC input contactor on the drive.
3. When using a PowerFlex 700/700S Frame 3 or 4 drive with a 1336 REGEN in the Regenerative Brake Configuration, one of the following methods must be used:
   - Provide an AC input contactor for the drive. The 1336 REGEN unit must be allowed to precharge the DC bus before closing the AC input contactor on the drive.
   - An alternative to using an AC contactor on the PowerFlex 700/700S Frame 3 or 4 drive is to connect to the BR1 terminal instead of the DC+ terminal. This method can be used only with Frame 3 or 4 on a 48A or 78A 1336 REGEN unit.

## Sizing

1. Convert all motor powers to kW (kW = HP x 0.746).
2. Determine the total power required during deceleration: (1)

$$P_{DECEL} = P_{MOTOR} * \text{Motor Efficiency}$$

   Calculate the input current required on the regenerative unit during deceleration, taking advantage of the 150% for 1 minute overload rating of the regenerative unit:

$$I_{INPUT} = P_{DECEL} \times 1000 / (\sqrt{3} \times V_{LL} \times 1.5),$$

   where $P_{DECEL}$ is in kW, and $V_{LL}$ = RMS line-to-line AC input voltage.

(1) $P_{MOTOR}$ is the motor power required for the application. The $P_{MOTOR}$ could be positive if that section of the machine is motoring or negative if that section of the machine is regenerating.

Discontinued

3. Determine the total power required during steady state run operation, if the steady state power is regenerative: (1)

   $$P_{RUN} = P_{MOTOR} * \text{Motor Efficiency}$$

   Calculate the steady state input current required on the regenerative unit:

   $$I_{INPUT} = P_{RUN} \times 1000 / (\sqrt{3} \times V_{LL}),$$

   where $P_{RUN}$ is in kW, and $V_{LL}$ = RMS line-to-line AC input voltage.

4. Compare the input current required for the regenerative unit during deceleration, and steady state.

   Select the regenerative unit with the input current rating that meets or exceeds the worst case regenerative input current.

## Fusing

### *AC Input Drives*

See the drive's documentation for AC input fusing of the drives.

### *AC Input 1336 REGEN*

See the 1336 REGEN User Manual for recommended AC input fusing of the 1336 REGEN unit.

### *DC Output 1336 REGEN*

The DC fusing is sized per the 1336 REGEN rating in this configuration because the regenerative unit is sized to handle only regenerative current. See the 1336 REGEN User Manual for recommended DC output fusing of the 1336 REGEN unit.

Discontinued
Discontinued

# 1336 REGEN Drive in Shared Regenerative Braking Configuration

## System Characteristics

The shared regenerative braking configuration is used when regeneration is needed for stopping or slowing down multiple drives. The regenerative brake puts energy back onto the distribution system instead of dissipating energy with resistor braking technology. Steering diodes only let regenerative current flow to the regenerative module so that one drive cannot source power to the other drives.

## Supported Products

At one time, these products were supported.

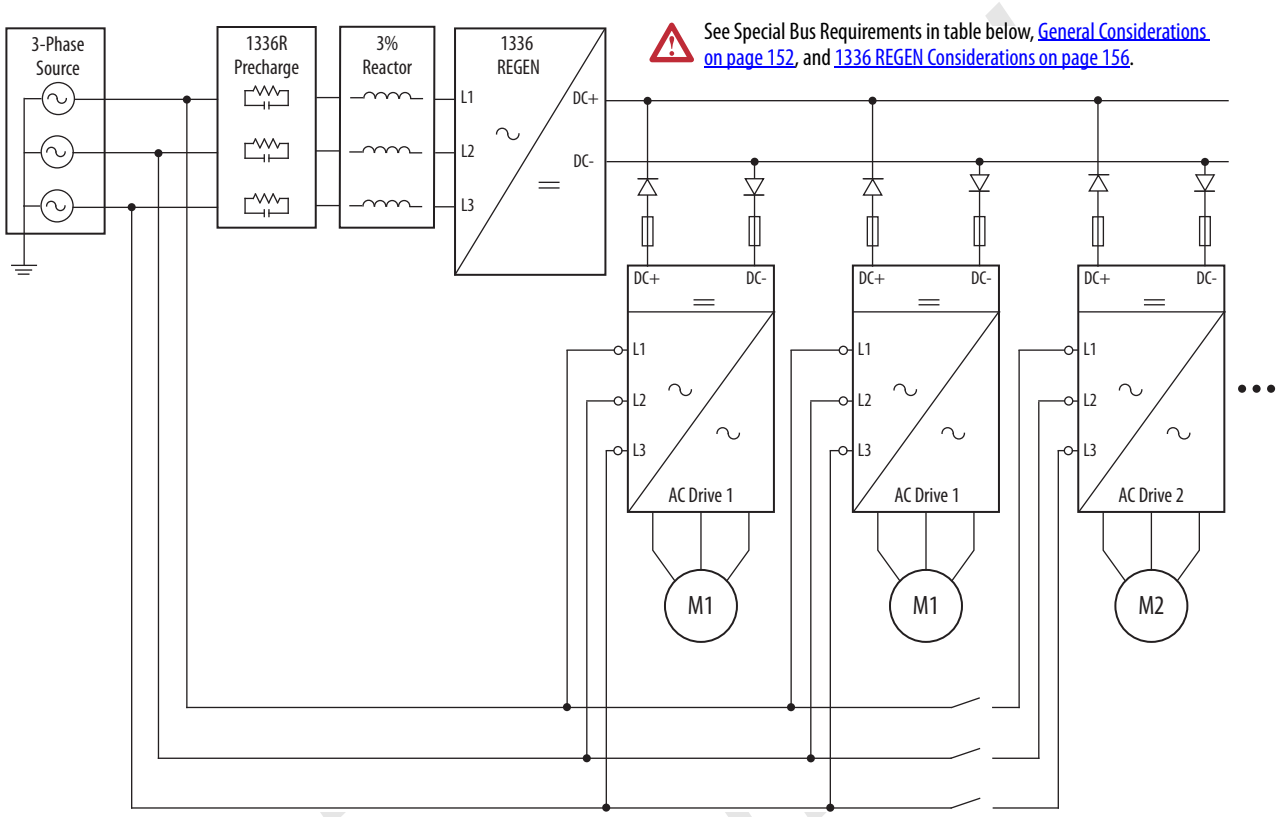
| Products | Supported Drives |
|---|---|
| 1336 REGEN (1) | PowerFlex 40P: All 400/480V AC power ratings |
| | PowerFlex 700 (2) / PowerFlex 700 Series B (2): All 400/480V AC frame sizes (3) |
| | PowerFlex 700S: All 400/480V AC frame sizes |
| | PowerFlex 700H: All 400/480V AC frame sizes |
| | PowerFlex 750-Series: Frames 1…7 (4) |
| | Kinetix 7000: BM06…BM12 |
| | Kinetix 7000: All 460V configurations |

(1) The 1336 REGEN is not CE compliant.
(2) These drives require firmware revision 2.001 or later (Standard and Vector Control).
(3) PowerFlex 700 Frame 5…7 DC input drives are required when not connected to the AC source.
(4) A DC input terminal kit must be ordered for PowerFlex 750-Series Frame 6 and 7 drives.

Discontinued
Discontinued

# Typical System Configurations

**Figure 61 - Shared 1336 REGEN Brake with AC Drives**




| Dwg. Designation | Supported Drives | Special Bus Requirements |
|---|---|---|
| AC Drive 1 | PowerFlex 700/700S: Frames 5 and 6 | Steering diodes must be used in a shared regeneration configuration to prevent imbalanced AC current sharing between the drives. |
| | PowerFlex 700: Frames 7…10 | |
| | PowerFlex 700H: Frames 9…14 | |
| | Kinetix 7000: BM09…BM12 | |
| | PowerFlex 750-Series: Frames 5…7 | • Steering diodes must be used in a shared regeneration configuration to prevent imbalanced AC current sharing between the drives.<br>• A DC input terminal kit must be ordered for Frames 6 and 7. |
| AC Drive 2 | PowerFlex 700/700S: Frames 0…4 | • When using these drives with a 1336 REGEN in the Shared Regenerative Brake Configuration, an AC input contactor must be provided for these drives. The 1336 REGEN unit must be allowed to precharge the DC bus before closing the AC input contactor on the drives.<br>• Steering diodes must be used in a shared regeneration configuration to prevent imbalanced AC current sharing between the drives. |
| | PowerFlex 750-Series: Frames 1…4 | |
| | Kinetix 7000: BM06…BM08 | |

Discontinued

## General Considerations

1. Disconnect the common mode capacitors from the drives when using a regenerative module. See the drive's documentation for instructions on disconnecting the common mode capacitors.
2. All system components (Bus Supply, PowerFlex Drives, and Braking Unit) must be selected for the same AC-line voltage.
3. A low inductance type DC bus must be used. The system must be contained in one contiguous line-up. The bus cannot be interrupted to go to another cabinet for the remainder of the system drives.

## 1336 REGEN Considerations

1. The 1336 REGEN Parameter 1- [Operational Mode] must be set to 'Regen Brake Mode' (default).
2. When using any of the following drives/drive systems with a 1336 REGEN unit in the Regenerative Brake Configuration, an AC input contactor must be provided for these drives.

| |
|---|
| PowerFlex 40P: All 400/480V AC power ratings |
| PowerFlex 700/700S: All 400/480V AC frame sizes |
| PowerFlex 750-Series: Frames 1…7 |
| Kinetix 7000: BM06…BM12 |
| Kinetix 7000: All 460V configurations |

   The 1336 REGEN unit must be allowed to precharge the DC bus before closing the AC input contactor on the drives.
3. Steering diodes must be used in a shared regeneration configuration to ensure AC current sharing between the drives. Bonitron (www.bonitron.com) sells diode sharing modules for connecting multiple drives to one regenerative brake (see Table 32 on page 133).

## PowerFlex 40P Drive Considerations

PowerFlex 40P drives **must not be used** on the same DC bus supply as PowerFlex 700/700S/700H/750-Series drives. This is due to the difference in capacitance/amp of the PowerFlex 40P drives compared to the PowerFlex 700/700S/700H/750-Series drives.

Discontinued
Discontinued

## Sizing

1. Convert all motor powers to kW (kW = HP x 0.746).
2. Determine the total power required during deceleration: (1)

   $$P_{DECEL} = P_{MOTOR} * \text{Motor Efficiency}$$

   Calculate the input current required on the regenerative unit during deceleration, taking advantage of the 150% for 1 minute overload rating of the regenerative unit:

   $$I_{INPUT} = P_{DECEL} \times 1000 / (\sqrt{3} \times V_{LL} \times 1.5),$$

   where $P_{DECEL}$ is in kW, and $V_{LL}$ = RMS line-to-line AC input voltage.
3. Determine the total power required during steady state run operation, if the steady state power is regenerative: (1)

   $$P_{RUN} = P_{MOTOR} * \text{Motor Efficiency}$$

   Calculate the steady state input current required on the regenerative unit:

   $$I_{INPUT} = P_{RUN} \times 1000 / (\sqrt{3} \times V_{LL}),$$

   where $P_{RUN}$ is in kW, and $V_{LL}$ = RMS line-to-line AC input voltage.
4. Compare the input current required for the regenerative unit during deceleration, and steady state.

   Select the regenerative unit with the input current rating that meets or exceeds the worst case regenerative input current.

## Fusing

### *AC Input Drives*

See the drive's documentation for AC input fusing of the drives.

### *DC Input Drives*

See Appendix A for the recommended Common DC Bus drive fusing.

### *AC Input 1336 REGEN*

See the 1336 REGEN User Manual for recommended AC input fusing of the 1336 REGEN unit.

(1) $P_{MOTOR}$ is the motor power required for the application. The $P_{MOTOR}$ could be positive if that section of the machine is motoring or negative if that section of the machine is regenerating.

Discontinued
Discontinued

## Notes:

Discontinued
Discontinued

# 1336 and AK DBU Brake Devices

This section is included only to support existing, installed systems with legacy (discontinued) brake products from Rockwell Automation. The external brake products in this section are no longer available. Please contact our encompass partners for braking products.

At one time, these braking module products were available:

- 1336-WA / -WB / -WC Brake Chopper Module
- 1336-MOD-KA / -KB / -KC Heavy Duty Dynamic Brake Unit
- AK DBU Dynamic Braking Unit

For more information on these products, sizing, and fusing requirements, see their respective documentation.

In certain configurations, an RC snubber circuit is required when using a 1336-W* Brake Chopper. The RC snubber circuit is required to prevent the DC bus voltage from exceeding the 1200V maximum Brake Chopper IGBT voltage. The 1336-W* Brake Chopper power-up delay time is 80 milliseconds. During this time, the IGBT does not turn on. The RC snubber circuit must always be connected to the DC bus (located close to the braking chopper) to absorb the power-on voltage overshoot. For RC snubber circuit specifications, see RC Snubber Circuit on page 136.

Discontinued
Discontinued

## Notes:

Discontinued
Discontinued

## Rockwell Automation Support

Rockwell Automation provides technical information on the Web to assist you in using its products. At http://www.rockwellautomation.com/support you can find technical and application notes, sample code, and links to software service packs. You can also visit our Support Center at https://rockwellautomation.custhelp.com/ for software updates, support chats and forums, technical information, FAQs, and to sign up for product notification updates.

In addition, we offer multiple support programs for installation, configuration, and troubleshooting. For more information, contact your local distributor or Rockwell Automation representative, or visit http://www.rockwellautomation.com/services/online-phone.

### Installation Assistance

If you experience a problem within the first 24 hours of installation, review the information that is contained in this manual. You can contact Customer Support for initial help in getting your product up and running.

| | |
|---|---|
| United States or Canada | 1.440.646.3434 |
| Outside United States or Canada | Use the Worldwide Locator at http://www.rockwellautomation.com/rockwellautomation/support/overview.page, or contact your local Rockwell Automation representative. |

### New Product Satisfaction Return

Rockwell Automation tests all of its products to help ensure that they are fully operational when shipped from the manufacturing facility. However, if your product is not functioning and needs to be returned, follow these procedures.

| | |
|---|---|
| United States | Contact your distributor. You must provide a Customer Support case number (call the phone number above to obtain one) to your distributor to complete the return process. |
| Outside United States | Please contact your local Rockwell Automation representative for the return procedure. |

## Documentation Feedback

Your comments will help us serve your documentation needs better. If you have any suggestions on how to improve this document, complete this form, publication RA-DU002, available at http://www.rockwellautomation.com/literature/.

Rockwell Automation maintains current product environmental information on its website at http://www.rockwellautomation.com/rockwellautomation/about-us/sustainability-ethics/product-environmental-compliance.page.

Rockwell Otomasyon Ticaret A.Ş., Kar Plaza İş Merkezi E Blok Kat:6 34752 İçerenköy, İstanbul, Tel: +90 (216) 5698400

**www.rockwellautomation.com**

**Power, Control and Information Solutions Headquarters**

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation NV, Pegasus Park, De Kleetlaan 12a, 1831 Diegem, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication DRIVES-AT002F-EN-P - April 2014
Supersedes Publication DRIVES-AT002E-EN-P - March 2011

Copyright © 2014 Rockwell Automation, Inc. All rights reserved. Printed in the U.S.A.